

Archives of Neurology and Psychiatry

VOLUME 17

JUNE, 1927

NUMBER 6

THE BRAIN OF PREHISTORIC MAN

A STUDY OF THE PSYCHOLOGIC FOUNDATIONS OF HUMAN
PROGRESS

FREDERICK TILNEY, M.D.

NEW YORK

The human family, according to most conservative authority, has been in existence for more than a half million years. During all the vast era of pleistocene time, with its recurrent glaciations and intervals of warmth, man's brain steadily grew. In volume, the cerebrum was slowly increasing. It developed gradual refinements in many of its structural details. Certain of its most recently acquired regions became still more highly specialized, until the brain of modern man has come to be a far more efficient organ than that possessed by the earliest of human kind.

Several distinct races of primitive men already have been identified by means of fossilized bones from the body and cranium. The racial differentiations established in this manner have been utilized to reconstruct the outward appearance of these prehistoric peoples. In the reconstructions of Professor MacGregor the differences between them are striking (fig. 1). The apelike appearance of *Pithecanthropus erectus* affords some reasons for calling this earliest known member of our family circle the ape-man. The old man of Cro-Magnon, on the other hand, possesses a nobility of expression which in itself seems to justify his characterization as the "Paleolithic Greek." Between these two extremes, Neanderthal man is obviously an intermediate stage. How these people felt, thought and lived is a matter of great ethnical importance concerning which the brain has much to reveal. This revelation is still more significant for what it discloses regarding the cultural progress and possibilities of mankind.

In order to gain some idea of what the brain of primitive man was like, it is necessary to depend on certain circumstantial evidence. This admission may seem to put the case in its most unfavorable light. The fact remains that the brain of man shared the same fate as other soft parts of his body. It has not disappeared, however, without leaving definite impressions of its size and shape. These impressions have been

found on fossilized cranial bones dating back to the earliest human races yet recognized. There is, of course, some question as to the value of such impressions in drawing conclusions about the brain. Professor Symington, who has investigated the subject extensively by means of endocranial casts, is extremely cautious in the matter. He prefers to admit frankly the limitations of our present knowledge rather than to reconstruct the brain of primitive man on too slender evidence. This wise admonition has been borne in mind throughout the following descriptions of the prehistoric human brain.

For the purpose of sensing the full value of endocranial evidence, it is important to recall that the bony capsule enclosing the brain is peculiarly susceptible to the effects of cerebral growth. Some portions of this capsule begin to form in cartilage and some in membrane. Four cranial bones have a membranous origin, i. e., the frontal, parietal and



TRINIL APE-MAN
Pithecanthropus erectus

NEANDERTHAL MAN
Homo neanderthalensis

CRÔ-MAGNON MAN
Homo sapiens

Fig. 1.—Three great races of prehistoric man. Models by Prof. J. H. MacGregor. Taken from "The Hall of the Age of Man" in the American Museum of Natural History. Through the courtesy of Prof. Henry Fairfield Osborn.

occipital bones and the squamous portion of the temporal bone. Expansion of the brain appears to be the dominant factor in the growth of the head. In consequence, the membranous bones of the skull bear many impressions of the cerebral hemispheres. These impressions would be more pronounced if the cerebral convolutions came into actual contact with the inner surface of the skull. But the interposition of the dura mater, the pia mater, the arachnoid and the cerebrospinal fluid in part obscures the imprint of the brain. A number of cerebral features, however, are consistently impressed on the endocranium. Schwalbe has shown that there are certain bony ridges corresponding to cerebral fissures and a number of depressions produced by cerebral convolutions. These Schwalbe called *juga cerebralia* and *impressiones digitatae*,

TABLE 1.—Principal Fossil Remains of Prehistoric Man (Pre-Paleolithic and Lower Paleolithic)

Antiquity	Name	Race	Discoverer	Place and Date	Parts	Period
500,000 years	Pithecanthropus erectus	Trinil	Dubois	Java 1891	Skull cap; teeth (3)	Eolithic ?
250,000 years	Paleoanthropus heidelbergensis	Heidelberg	Schoetensack	Heidelberg 1907	Lower jaw with teeth	Eolithic ?
150,000 years	Eoanthropus dawsoni	Pittdown	Dawson	Sussex 1911	Parts of skull and jaw	Early paleolithic
130,000 years?	Homo rhodesiensis	Rhodesian	Harris	Rhodesia 1921	Fragments of femur, tibia, sacrum; skull (no lower jaw)	?
120,000 years	Homo neanderthalensis	Neanderthal	Flint	Gibraltar 1848	Skull	Early paleolithic (probably)
			Bourret and Regnault	Malarnaud 1886	Jaw (m)	Early paleolithic (probably)
			?	Arcey-sur-Cure 1859	Jaw (m)	Early paleolithic (probably)
			?	Gourdan ?	Fragment of lower jaw	Early paleolithic (probably)
			Dupont	La Naulette 1866	Lower jaw	Early paleolithic (probably)
			Torrent	Banolas 1887	Lower jaw	Early paleolithic (probably)
			Fuhlrott	Neanderthal 1856	Top of skull; a number of skeletal fragments	Early paleolithic (probably)
			?	Oches 1903	Fragment of lower jaw	Early paleolithic (probably)
75,000 years	Homo neanderthalensis	Neanderthal	Nehring	Ehringsdorf and Taubach 1892-1914	Lower jaw two teeth decidual; fragments of child's skeleton; three fragments of skull-cap; femur	Pre-Mousterian or Acheulean ?
			Kramberger	Krapina 1899	Fragments of skulls; skeletons of eleven (?) individuals	Pre-Mousterian or Acheulean ?
				Neu-Essing Klause	One molar	Pre-Mousterian or Acheulean ?
				Galilee Gibraltar II 1926	Skull	?
50,000 years	Homo neanderthalensis	Neanderthal	Hauser	Le Moustier 1908	Skull crushed; skeleton; ceremonial burial	Mousterian
50,000 ? years	Homo neanderthalensis	Neanderthal	Kampfe	Ehringsdorf 1914	Jaw (see Taubach)	Mousterian
40,000 years	Homo neanderthalensis	Neanderthal	Maska	Sipka 1882	Fragment of lower jaw	Mousterian
			Bonyssouie Bardon	La Chapelle aux Saints 1908	Skull (m) almost complete; skeleton; ceremonial burial	Mousterian
			Martin	La Quina 1911	Skull (f) well preserved; skeleton; child's skull; skeletal fragments	Mousterian
30,000 years	Homo neanderthalensis	Neanderthal	Peyrony and Capitou	La Ferrassie 1909-1910	Skeletons (impl.); two adults; four children; ceremonial burial	Mousterian
			Peyrony	Pech de L'Aze 1909	Skull of child	Mousterian
			Peyrony	Petit-Puy-moyen 1907	Fragments of jaws (maxillae)	Mousterian
			Puydt Pralpont and Lehest	Spy 1887	Two skeletons	Mousterian
			Marett	Jersey 1910	Thirteen teeth	Mousterian

TABLE 2.—Principal Fossil Remains of Prehistoric Man (Upper Paleolithic)

Antiquity	Name	Race	Discoverer	Place and Date	Parts	Period
25,000 years	Homo sapiens	Cro-Magnon	?	Aurignac 1852 ?	.....	Aurignacian
			Lartet	Cro-Magnon 1868	Four individuals: one fetus, two men and one woman well preserved	Aurignacian
			Verneau	Grotte des Enfants 1884 (Grimaldi)	Six skeletons (two negroid)	Aurignacian
			Riviere	Grotte du Cavillon 1872 (Grimaldi)	One skeleton (6.55 m.); packet of bones in ocher at base	Aurignacian
			Abbo	Barma Grande ? (Grimaldi)	Six skeletons	Aurignacian
			?	Baouaso da Torre	Two skeletons (adult); bones of child	Aurignacian
			Hauser	Combe Capelle 1907	One skeleton	Aurignacian
			Sierra	Camargo ?	Skull fragments	Aurignacian
			Obermaier	Willendorf 1908	Fragments of femur, humerus, upper and lower jaws	Aurignacian
			Cro-Magnon	Enzheim Paviland 1823	One skeleton	Aurignacian
			(Sub-brachyceph. not Cro-Magnon)	Ojeu Solutre	One skull top	Aurignacian
			Deperet Arcelin and Mayet		Five skeletons	Aurignacian
20,000 years	Homo sapiens	?	Daleau	Pair-non-Pair 1896	Skull fragments (parietal)	Solutrean
			Vire	Lacave ?	Frontal skull fragments	Solutrean
			?	Roset ?	Teeth	Solutrean
			Pre-Imost or Brünn ?	Predmost 1880	Fourteen skeletons; remains of six (?) other individuals	Solutrean
			Brünn ?	Makowsky	One skeleton	Solutrean
			Brünn ?	Hillebrand	One child's skull	Solutrean
				Langerie-Haute	One skeleton	Solutrean
				Nal-Essing	One skeleton	Solutrean
			Cartailhac	LaMadeleine 1864	One skeleton	Magdalenian
			Massenat	Langerie-Basse 1872	One skeleton	Magdalenian
			?	Testut	Chancelade 1888	Magdalenian
			Cro-Magnon	.....	Cap-Blanc	Magdalenian
15,000 years	Homo sapiens	Cro-Magnon	Duruthy	.....	One skeleton	Magdalenian
			Tournier	Les Hoteaux	One skeleton	Magdalenian
			Karsten	Freudenthal 1874	Skeletal and skull fragments (parietal, mandible, teeth)	Magdalenian
			.....	Le Placard 1883	One skull (f); nine cups made of skull tops; skeletal fragments	Magdalenian
			Verworn	Obercassel 1914	Two skeletons	Magdalenian
			Bonnet	.....	.....	.....
			Steinmann	.....	.....	.....
			Bonyssonie	Limeuil	Skull fragments	Magdalenian
			.....	Grotte des Hommes	Three skulls	Magdalenian
			Daleau	Grotte des Fees	Fragments of upper and lower jaws	Magdalenian

TABLE 2.—Principal Fossil Remains of Prehistoric Man
(Upper Paleolithic)—Continued

Antiquity	Name	Race	Discoverer	Place and Date	Parts	Period
15,000 years	Homo sapiens	Cro-Magnon	Breuil	Lussac	Lower jaw	Magdalenian
			Piette	Mas d'Azil	One skull top	Magdalenian
			Nelli	Espeugues or Lourdes	Various fragments	Magdalenian
			.....	Castillo	Two skull fragments worked into bowls or cups (child's lower jaw, one adult molar)	Aurignacian
10,000 years	Homo sapiens	?	.....	Furfooz	Skull	Uncertain probably Neolithic
		Cro-Magnon	R. R. Schmidt	Ofnet	Thirty-three skulls	Azilian
		Cro-Magnon	.....	Hexenküche Bavaria	One skull	Azilian

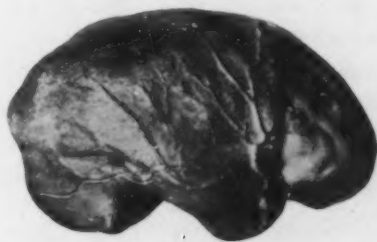


Fig. 2

Fig. 2.—Endocranial cast of *Pithecanthropus erectus* showing the lateral view of the hemisphere. The irregular line near the base indicates the lower limits of the cranial fold.



Fig. 3

Fig. 3.—Endocranial cast of *Pithecanthropus erectus* showing the impression of the superior surface of the brain. The frontal lobes and their convolution are especially well developed.

Juga and impressions appear in the separate cranial bones as follows:

In the frontal bone: pars squamosa, the superior frontal convolutions; pars orbitalis, the orbital convolutions; pars temporalis, the inferior frontal convolution.

In the parietal bone: postero-inferior triangle (Schwalbe), usually some impressions of the parietal convolutions; the parietal fossa corresponding to the parietal eminence; the crista Sylvii marking the posterior ramus of the sylvian fissure.

In the temporal bone: pars squamosa with the greater wing of sphenoid, the middle temporal sulcus and the second and third temporal gyres.

In the occipital bone: the impressiones occipitalis, crista occipitalis, crista marginalis and the juga cerebellaria.

In the fossilized skull these features become landmarks of utmost importance as guides to establish functional localization in the brain of primitive man.

The more important fossilized skulls, discovered either in part or largely intact, are described in the accompanying tabulations. To the data are added the names of the discoverers and the place and date of the discovery. Further specifications are included to indicate the estimated antiquity and the race of man to which each fossil specimen has been accredited (tables 1 and 2).

THE BRAIN OF PITHECANTHROPUS ERECTUS, THE APE-MAN OF JAVA

According to prevailing opinion, the most ancient human fossil is that of *Pithecanthropus erectus* (figs. 2 and 3). To it an antiquity of not less than 500,000 years is assigned. Although the humanity of this fossil is disputed by some authorities, the testimony it bears indicates a primate standing relatively high in the scale—much higher indeed than any of the great apes. The fossilized part of the skull consists of the calvarium, which includes the greater portion of the frontal squamosa and the parietal bones, a part of the occipital bone and perhaps a small fragment of one temporal squamosa. The preservation is fairly symmetrical on the two sides of the cranium. For further descriptions of this fossil the reader is referred to Dubois' monographs on the subject.

The calvarium is particularly valuable because it retains many significant impressions and juga indicating the configuration of the brain. A cast made from the pithecanthropus calvarium reveals a number of features that furnish valuable information concerning the brain of the Javan man. The parietal area shows clearly the distribution of the middle meningeal artery, also the eminence and groove corresponding, respectively, to the parietal fossa and crista Sylvii. The relief in the occipital region marks the grooves and convolutions corresponding to the occipital impressions, the crista occipitalis, the crista marginalis and the juga cerebellaria.

From these data it is possible to introduce certain boundaries on the lateral surface of the cast and thus establish the probable position of several functional areas in the brain.

The posterior branch of the sylvian fissure extends from the fronto-temporal notch to the lower margin of the parietal eminence. The full extent and terminal disposition of this fissure cannot be determined, and hence it is not possible to indicate the character or position of the supra-marginal convolution.

The fissure of Rolando (sulcus centralis) may in a general way be placed between the two main branches of the middle meningeal artery and in front of the parietal eminence. Estimated by the anthropometric criteria of this fissure now generally accepted, the upper extremity of the fissure may be placed on or near the superior longitudinal groove about 2 cm. posterior to its midpoint calculated as half the distance from the frontal to the occipital end of this groove. The general direction of the rolandic fissure may likewise be estimated as a descending line which leaves the superior longitudinal groove at an angle of inclination forward at somewhere between 67 and 71.4 degrees. The allocation of this most important boundary is extremely generalized and must of necessity omit many essential details of the sulcus. It does not afford any intimation as to the extent of the fissure, or the relations of its upper and lower extremities to the superior longitudinal fissure on the one hand and the fissure of Sylvius on the other. Neither does it denote the presence of the usual genuflexions conspicuous in the human central sulcus. The position and disposition of the rolandic fissure assigned to the brain of pithecanthropus depend more on deduction and analogy than on actual indications on the cast. It is desirable, however, to establish certain approximations regarding the character and position of this fissure.

The third landmark is the groove of the transverse sinus, which indicates the planes of separation between the occipital lobes of the cerebral hemispheres and the cerebellum. This groove with the superior longitudinal furrow marks the position of the torcular herophili.

These boundary lines determine the general extent of four great lobes in the brain, namely, the frontal, parietal, temporal and occipital. It is possible in the light of this topography to consider the characters and significance of each lobe separately.

Frontal Lobe.—This appears as a particularly conspicuous portion of the hemisphere. It is prominent especially because of its large size and pronounced convolutions. Near the middle of the frontal convexity and in juxtaposition with the superior longitudinal fissure is a prominent pacchionian enlargement. The relief of the frontal convolutions is especially noteworthy, as it gives this region of the brain an individuality not possessed by any other area. This observation does not imply that the convolutional process is supreme in the frontal lobe of pithecanthropus. It demonstrates, as Schwalbe previously has shown, that the frontal squamosa is more impressionable to brain growth than other parts of the skull. It is fortunate, moreover, that such is the case, for it is this region of the hemisphere that has the most to reveal regarding the higher psychic development of the brain. Nor should it be overlooked that this frontal lobe represents the latest accessions of human specialization whereby man has distinguished himself in creation and finally acquired all that is implied in the title *Homo sapiens*.

There is a slight asymmetry in the size and shape of the frontal lobes, the left being somewhat larger. This also applies to the frontal convolutions of the left side. In relative size the frontal area represents on its lateral surface more than one third of the entire exposed convexity of the hemisphere. The two frontal lobes together, when viewed from above, give the impression of a truncated pyramid. There is a marked bluntness at the frontal pole and the outlines extend backward with a gradual widening to the level of the rolandic fissure. This general broadening is not consistently maintained. In one zone there appears to be a considerable constriction. For purposes of subsequent identification, this zone



Fig. 4.—Comparison of the endocranial cast of an adult gorilla with that of *Pithecanthropus erectus*. Impressions of the superior surface of the brain.

is called the coronal constriction. It begins at either frontotemporal notch and follows the impression of the coronal suture to the midline.

As compared with the primate frontal lobe nearest to that of man, that of the gorilla, the brain of *pithecanthropus* shows manifest differences (fig. 4). The frontal lobe as a whole is much less conspicuous in the gorilla. It is actually and relatively smaller. The relief of its convolutions is much less pronounced; its shape is more pyriform as it tapers toward its apex at the frontal pole, and it does not have a coronal constriction. The left lobe of the Javan man is slightly larger than the right, which is probably indicative of unidexterity. All of these differences

point to a distinctly inferior development in the frontal lobe of gorilla as compared with pithecanthropus. A comparison with the brain of *Homo sapiens* shows at once what decisive gains the brain of modern races has made over its simple prototype of primitive man (fig. 5). In size and general appearance the brain of pithecanthropus resembles that of a 3 year old child.

The fissures in the frontal lobe that may be identified with certainty are the superior and middle frontal sulci. They are tortuous and bound correspondingly complex convolutions. These fissures are most pronounced in the prefrontal area and may not be traced back as far as the

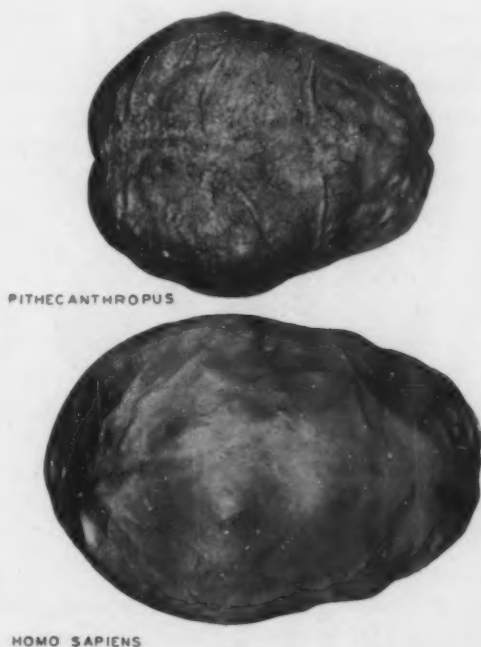


Fig. 5.—Comparison of the endocranial casts of *Pithecanthropus erectus* and *Homo sapiens*. Impressions of the superior surface of the brain.

frontal region. The convolutions determined by the frontal sulci are the superior, middle and inferior frontal gyres. The last of these is of greatest importance, since the inferior frontal convolution, especially on the left side, is almost universally regarded as the center of motor speech in man. In connection with this convolution, some authorities have identified the anterior ascending and horizontal branches of the sylvian fissure. If present in pithecanthropus, however, they exist merely as the faintest traces which afford insufficient ground for their acceptance as definite cerebral landmarks. In *Homo sapiens* these sulci are conspicuous and impart much prominence to the inferior frontal convolution.

There is not any indication of the precentral fissure, and hence an actual guide to the limits of the precentral or motor convolution is absent. How extensively this region of the cortex in pithecanthropus is provided with an intermediate precentral area for skilled movements cannot be determined. The basal surface of the frontal lobe as shown in supplementary reconstruction by Professor MacGregor indicates the presence of two orbital concavities of considerable depth and well developed interorbital keels—in other words, conditions far more primitive and pithecoïd than those in modern man.

Estimated from the physiologic standpoint, the frontal lobe of pithecanthropus is indicative of a behavioral advance far above the plane of gorilla but equally below that of *Homo sapiens*. The Javan man must have possessed greater powers of adaptive association. He was capable of more advantageous reasoning than gorilla or other anthropoids. He constructed for himself a greater sphere of experience, created at least an approach to human personality and developed the distinctive charac-

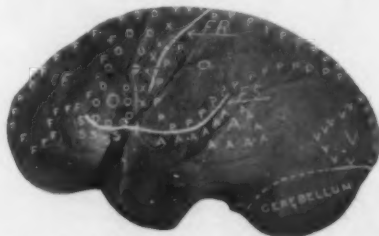


Fig 6.—Functional localization outlined on the surface of the left hemisphere in *Pithecanthropus erectus*. In this figure and figures 9, 12, 15 and 18, *A* indicates auditory function; *F*, higher faculties—personality and judgment; *FR*, fissure of Rolando; *FS*, fissure of Sylvius; *O*, skilled movements; *P*, sensory; *S*, speech; *V*, visual; *X*, voluntary control.

ters of individuality. It is probable also that in his manual dexterity he was right-handed. At least the greater size of his left frontal lobe suggests that his brain had singled out one hand as the chief representative for externalizing its activities. This in itself is a distinctly human character. Around it are built many of man's most productive specializations. In all of these respects, the Javan man was much below his human successors. There is little in his brain by which to judge the proficiency of his manual development, to estimate how much skill he had acquired with his hands. But the prominence of his inferior frontal convolution (fig. 6) strongly suggests that he had added one supreme advantage to the motor equipment of animal life. He had learned to speak—to communicate in verbal language. The gradual development of skilled acts eventually had combined the effector organs of articulation and phonation into a coordinated apparatus controlled through the brain by which he was able to express his ideas and feelings. The means of communication thus established laid the foundations of human knowledge.

The degree to which pithecanthropus may have developed language cannot be implied from anything in the external appearance of his brain. Doubtless his linguistic attainments were extremely crude. On the other hand, the fact that the cerebrum manifests such pronounced advances over the anthropoid brain in an area so intimately identified with speech in *Homo sapiens* signifies the decisive step that pithecanthropus had made in the development of human kind.

With all due allowance for the reservations imposed by morphologic limitations, the frontal lobe of the Javan man clearly indicates that the brain had progressed in its psychic capacity and that it had expanded in those portions on which unidexterity, reason, language and human personality depend.

Parietal Lobe.—This lobe of pithecanthropus also gives evidence of expansion, although the details of this development are less conspicuous than in the frontal area. It is impossible to discern the relief of any convolutions, nor, with the exception of the sylvian fissure, may any critical impressions be detected. Discrete boundaries between the frontal and parietal or between the occipital and parietal lobes may not be distinguished. The hypothetical position of the rolandic fissure provides the anterior limits of the parietal area. The increased prominence of the parietal eminence, together with the general widening of the cerebrum in this region, denotes a considerable extension of the neopallium. As compared with the corresponding area in gorilla, this expansion is emphatic. In contrast to the parietal lobe of *Homo sapiens*, it is distinctly inferior. The parietal lobe as a whole represents the neopallial area for the elaboration of somesthetic sensibility. The expansion of this area must be regarded as incidental not only to the augmented influx of sensory impressions but also to the increased complexity of their association. Three somatic factors have been held especially responsible for this increase. First, the development of the human or humanoid foot; second the assumption of the erect posture; and third, the emancipation of the hand from locomotor functions. Of these factors, the third has perhaps the greatest cogency. The increase in the parietal eminence involves a cortical area assigned to sensory perceptions of the upper extremity.

Occipital Lobe.—This lobe is little more productive of cerebral landmarks than the parietal. The occipital pole of the brain extends over the cerebellum, while the divergence of the two hemispheres is pronounced in this region. A bilaterally symmetrical groove corresponding to the transverse sinus separates the cerebellum from the cerebrum and thus establishes the caudal boundary of the occipital lobe. Any other boundary of this lobe is not discernible in the cast nor does any indication appear either of a sulcus simiarum (sulcus lunatus—Smith) or of a parieto-occipital incisure. The demarcation between occipital and parietal lobes

is therefore wholly conjectural. The latter indefiniteness, however, does not impose an embarrassment more serious than is the case with *Homo sapiens* in whom the occipitoparietal dividing line is an arbitrary one. It is probable that in the human brain there is an intermediate, transitional area between the parietal and occipital lobes in which the cortical types of these two regions manifest a histologic mutuality. This area permits of a physiologic blending in the activities of the two zones. In the apes, and more particularly in the great man-like apes, a sharply defined boundary created by the sulcus simiarum exists between the two regions. An actually homologous fissure does not appear in the cerebrum of modern man, although several authorities maintain that the sulcus lunatus closely resembles the simian fissure and may be identified in some human brains.

In the occipital lobe on the right side, a long crescentic fissure begins at the superior longitudinal fissures. It curves downward and forward in the general direction of the sigmoid sinus, thus appearing on both the occipital pole and the lateral convexity. Above and below it is the relief of an occipital convolution. The markings on the left occipital lobe are less definite. A transverse ridge extends transversely outward from the lambda across either occipital area. This ridge indicates the position of the lambdoid suture.

In comparison with gorilla, the occipital lobe of pithecanthropus shows considerable expansion in all diameters. As compared with the similar region in modern man, this lobe appears much smaller. It seems permissible, however, to presume that in his visual organization the Javan man had advanced a long distance above any of the anthropoids. His visual associations must have been much more extensive if it is true, as seems to be the case, that he had real powers of speech. His visuo-psychic functions must have undergone notable expansions as he began to attach verbal names to what he saw about him, thus laying the foundations of that wide sphere of denomination and enumeration that mankind has created. The telencephalization of vision has made great strides in pithecanthropus. He was capable of a more effective appreciation of his environment and not the least important element in this increased effectiveness found its expression in the better control he gained over his hands through visual supervision. The many and profound influences arising from such improved visual guidance made themselves felt in innumerable ways on his psychic organization, on the makeup of his personality and experience and on his capacity to learn. So also was his entire psychic life affected by the increased facility with which sensory impressions of sight, hearing and body sense entered into more complex associations.

Temporal Lobe.—This lobe in the pithecanthropus brain is little, if at all, represented in the calvarium. Some slight portion of the superior

temporal convolution may be detected, but scarcely enough to permit of more than a conjecture as to its character. The base of this lobe as seen in the occipitoparietal region indicates an increase in all diameters. Professor MacGregor's supplementary reconstruction likewise shows decisive expansion in this lobe. The most pronounced cortical increment appears to have involved the superior and middle temporal gyres in the area assigned to auditory function. Although it seems unwise to be categorical in this matter, all of the available evidence warrants the assumption that the sense of hearing had followed the example of sight and body sense in seeking broader fields for its activities in the neopallium. Such auditory expansion is indispensable to vocal speech, since symbolic sounds must first be acquired through hearing before they may be reproduced by articulation.

Comment.—All four of the great neopallial lobes of the pithecanthropus hemispheres give evidence of increased size and, hence, augmented functional capacity when compared with the great man-like apes. They are all, on the other hand, inferior to similar regions of the brain of living races.

Any opinion in the endeavor to estimate what dynamic factors induced the advanced development of the brain in pithecanthropus necessarily must be based on conjecture. The major somatic variants in primate organization express themselves in the mode and posture of locomotion, in the differentiation of the foot and in the specialization of the hand. To the reactions and interactions of these variants the primate brain has made definite responses. The cerebral area most sensitive to and most consistently affected by such modifications has been the parietal lobe. This region represents those activities engaged in sensing the body in both its axial and appendicular parts. In primates the axial segments have a greater structural fixity than the limbs, whose functional adaptations have manifested a far wider range of adjustment. In this light the expansion of the sensory regions in the parietal lobe particularly related to the leg and foot, arm and hand, becomes highly significant. It seems most probable that sensory increment in these areas must be an essential antecedent to any expansion in the realm of more highly complex motor performance. Kinesthetic sensibility is a fundamental requisite to all skilled acts. Without it neither the motion formula nor the motor execution would be possible. For this reason the development of new sensory fields must have been closely associated with the appearance of new motor territories, if they did not actually precede them.

From the femur of pithecanthropus, it is assumed that he stood and walked erect much as do his modern successors. The assumption of such erect posture entailed an extensive sequence of adaptive modifications all of which were reflected in the brain. Standing upright in itself requires a complex sensory mechanism to receive and adjust the

impulses from the proprioceptors. How intricate and essential this mechanism is may be seen in those diseases characterized by pathologic changes in the sensory system. Locomotor ataxia is an outstanding example. Here the disease is confined to the sensory elements but expresses itself preeminently in the motor adjustments of standing and walking.

To what extent sensory orientation of the body is essential to proper voluntary movement is seen in such pathologic conditions as acagnosis, in which the patient loses his limb sense to the degree that he may not appreciate the positions of his extremities nor recognize passive movements of them. The adequate sensing of the different parts of the body in rest and action is essential to kinesthetic sensibility and the indispensable physiologic basis of all voluntary movements. The transactions of this highly specialized sense are the function of the parietal lobe. As they become more extensive and complex, the parietal area has expanded to meet the new demands made on it. Throughout the long history of primate adaptation and progress, the parietal lobe has manifested the most consistent expansion. It has seemed to keep pace especially with the progressive tendency to assume the erect posture, to develop plantigrade locomotion and to acquire bimanual characters. If the parietal expansion is a reliable index to the evolution of kinesthetic sensibility, then this essential attribute of voluntary movement became more extensive in direct proportion as the upper extremity was emancipated to perform the duties of the human hand. A simple example may suffice to elucidate this point. The individual digits in the paw of a cat or a dog have not acquired independent movements similar to fingers. Their sensory representation in the brain is consequently much less, and requires less cortical area. The many individual movements of the fingers have need of much more cortical surface for their sensory orientation. It would seem to follow that the sensory demands of a foot so specialized as to support the body on the ground in the upright posture, thus freeing the hand for constructive and acquisitive purposes, called on the brain for its supreme development in the parietal lobe.

Simultaneously with the expansion in kinesthetic sensibility, the motor areas of the cerebral cortex have enlarged. By their extension they have increased their capacity for the creation of more numerous and varied motor patterns. They have gradually developed all of the motor formulas essential to the almost innumerable skilled manipulations of human hands. Much emphasis has been laid on the expansion of the sensory portion of the brain which may thus seem to play the leading rôle in development. But motor expansion has gone hand in hand with sensory. These two factors are inseparably connected. They appear to be only different phases of the same process; namely, the conversion of energy through the agency of animal organization. The stream of

impulses that flows in from the outer world by the avenues of the senses is transformed into the specific energy characteristic of each form of animal life and is finally transmitted to the effectors in which it appears again in specifically purposive reactions. The intricacy of the apparatus for the intake and that for the output vary directly with the complexity of reaction. They are both, therefore, parts of the same energy-transforming mechanism. It is impossible to consider the sensory organization of the brain apart from the motor. This applies to all types of sensibility. The expansion in visual capacity indicated by growth in the occipital lobe supports this view. For as voluntary acts became capable of more effective performances, visual functions were increasingly more necessary to their acquisition and control. Hearing, as the instigator and guide of new motor progress, may seem to carry less responsibility than the other senses except in one transcendent particular. Auditory function made possible the recognition and imitation of the many voices of nature. It finally became the guide of motor impulses for the tongue, larynx, lips, cheeks and throat until the audible energy of the outer world was transformed into spoken sounds of the human voice. Sounds of this kind eventually assumed symbolic associations with gestures and other movements of the body, with objects seen or otherwise perceived. The inception of human speech had its structural basis in the first and second temporal convolutions whose expansion is at least indicated in *Pithecanthropus*. These gyres represent the fundamental sensory elements of speech while the inferior frontal convolution constituting Broca's area exercises motor control over spoken language. All of these expansions in the several different areas of the brain are ultimately reflected in development of the frontal lobe. The cumulative effects of many factors impress themselves on this region. The assumption of the erect posture, the freer use of the hands, the fuller sensing of the world, the acquisition of speech and constructive proclivities, the incentive to explore and the ability to migrate contributed to broaden human experience and to increase the capacity to learn therefrom. The part they played in individualizing human personality, in expanding the powers of selection and in creating the foundations of judgment and reason is obvious. All of these higher psychic faculties are now attributed to the frontal lobe.

In the evolution of structure and behavior indicated by the brain of *Pithecanthropus erectus*, many factors have reacted and interacted. It is doubtless true that not any single formula attempting to outline the sequence of events in this process would be wholly satisfactory or correct. Some working program of this kind, however, is not objectionable and may be helpful if its hypothetical nature is frankly admitted. The following summary of such a sequence visualizes *pithecanthropus*

as departing from the orthograde stem of the primates and making decisive advances beyond the anthropoid stage by:

1. The development of more extensive kinesthetic and motor capacity.
2. The assumption of the erect posture.
3. The freeing of the hand for manual performances and the inception of unidexterity.
4. The expansion of visual and auditory sensibility.
5. The development of speech.
6. The establishment of human personality and the higher psychic faculties.

THE BRAIN OF PILTDOWN MAN,
EOANTHROPUS DAWSONI

The fossilized remnants of the skull of the Dawn Man are more fragmentary than in the case of the Javan ape-man (figs. 7 and 8). It was therefore necessary to give each fragment its proper place in reconstructing the skull of this long extinct race of men. These Piltdown cranial fragments include: (1) the left parietal bone and part of the right; (2) the left temporal bone in its squamous, petrous and mastoid portions; (3) a large part of the left half of the frontal squamosa; (4) about two thirds of the occipital bone; (5) the right half of the mandible.

The first reconstruction of the Piltdown skull was presented to the Geological Society in London in December, 1912, by Dr. A. Smith Woodward, of the British Museum, and Mr. Charles Dawson, a lawyer, who had made the original discovery of the fossil. The announcement of this remarkable find deeply stirred the interest of scientific circles. An unknown phase of early human existence was about to be revealed. The reconstructed skull as pieced together by Dr. Woodward impressed all who saw it as a strange blend of man and ape. It seemed that the missing link for which the early followers of Darwin had arduously searched was at length forthcoming. But whether this was the long sought missing form or not, the Piltdown strata in the weald of Sussex, not many miles from the English Channel, told of a race of human beings who inhabited England long before history had made its feeblest beginnings. The stratum in which the Piltdown fossil rested indicated an antiquity, according to Dr. Woodward, dating back to the early part of the pleistocene period. The estimates of this geologic period in terms of years vary considerably. Such authorities as Professor Sollas and Professor Penck, for example, believe the period comprised between 400,000 and 500,000 years. Professor Rutot is more conservative and sets the figure at 140,000 years. Sir Arthur Keith, who made a subsequent reconstruction of the Piltdown skull, advocates an antiquity even more remote, dating back to some portion of the pliocene. Even if it is impossible to be more exact in these estimations of geologic time, it

seems clear that a primitive race inhabited England long before Caesar's invasions, in fact, ages before the ancient Britons claimed the land that was destined to produce the most brilliant lights of history.

Endocranial casts of the Piltdown skull have been made by Dr. Woodward and Sir Arthur Keith. These reproductions vary in certain details, particularly in regard to the arch of the vertex and the estimated volume of the brain. Both of the casts show a distinct superiority when compared with that of *pithecanthropus*. Especially decisive is the gain made by the Dawn Man in the vault of his skull and the expanse of his forehead. The general flatness in the cranial vault of the Javan ape-man gives place to a degree of arching in the Piltdown skull. This modification is in response to expansions in the frontal and parietal regions. However, increasing proportions are not limited to these areas. The

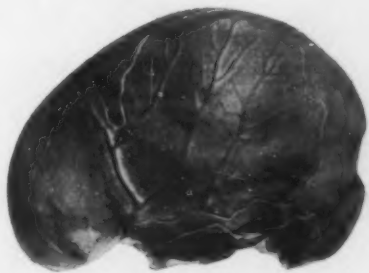


Fig. 7

Fig. 7.—Endocranial cast of Piltdown man, showing lateral view of left hemisphere. The irregular line near the base indicates the lower limits of the cranial fossil.



Fig. 8

Fig. 8.—Endocranial cast of Piltdown man, showing the impression of the superior surface of the brain. The irregular line indicates the limits of the cranial fossil.

temporal as well as the occipital lobe of the Dawn Man have enlarged. By comparison it is evident that the brain of the ape-man was smaller, less well developed and less specialized. The volume of the *pithecanthropus* brain as originally estimated by Dubois was 855 cc. Subsequent measurements with corrections by MacGregor place this figure at 940 cc. The volume of this brain, while considerably above the average for the gorilla, which is between 500 and 545 cc., is much below that of the average adult human brain of modern races. Professor Elliot Smith maintains that a brain must reach the weight of 955 Gm. (about 1,000 cc.) before it can serve the ordinary needs of human existence. Woodward eventually estimated the volume of the Piltdown brain at 1,195 cc., but

Keith's investigation increased this figure to approximately 1,400 cc., or well up to the average of the modern man. The volume of the gorilla's appears to be 57 per cent of that of *pithecanthropus*, while that of *pithecanthropus* is about 72 per cent of the volume of the Piltdown brain. This difference denotes more rapid expansion of the brain in the direction of the higher human standard once the limits of actual anthropoid conditions are transcended. The impetus toward human specializations, even in their early human incipency, seems to hasten the progressive development of the brain more than any of the less advanced primate stages. Some of the increase in the volume of the brain of most primates might be attributed to the general increase in the structure of the body. Such, however, can scarcely be the case, since a gorilla weighing nearly 400 pounds, or more than twice as much as the average man, possessed a brain whose volume was only 545 cc., approximately one third that of man. Dubois and Keith endeavored to determine how much of

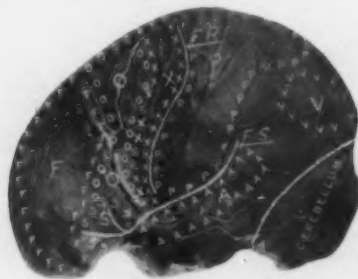


Fig. 9.—Functional localization outlined on the surface of the left hemisphere in Piltdown cast.

the brain is needed for purely animal contingencies and size of body. They concluded that these factors are represented by not more than 6 to 8 per cent of the entire cerebrum. Between 92 and 94 per cent of the volume of the human brain is therefore determined by factors other than the vital functions or the size of body.

Three salient landmarks on the cast are, all things considered, less impressive than in *pithecanthropus*. The fissure of Sylvius may be discerned at the frontotemporal notch where its posterior limb begins to pass backward beneath the parietal eminence. The termination and ultimate disposition of this fissure cannot be determined. It presents a faintly indicated anterior ascending ramus and also a horizontal ramus extending into the frontal lobe. The position of the rolandic fissure may be estimated by the general rules previously applied to this sulcus in the *pithecanthropus* brain. The groove of the transverse sinus is well defined but seems open to considerable criticism, especially concerning its obliquity, as given in the endocranial cast. As a whole, the occipitocere-

bellar area is the least satisfactory region of the entire cast. Subsequent studies may correct this deficiency and produce an occipital symmetry more in keeping with this portion of the normal skull.

Frontal Lobe.—This lobe of the Dawn Man presents much less in the way of frontal impressions and juga than pithecanthropus. It does not offer any more convincing indications as to the position of the rolandic fissure. The coronal constriction is much less marked than in the Javan man, thus showing a real expansion in the frontal lobe. In one feature this area does stand out by comparison. The inferior frontal convolution of the Piltdown brain is much more prominent than in pithecanthropus. In it are apparent those extensions of the sylvian fissure so notable in connection with the area of motor speech of *Homo sapiens* (fig. 9). The increased size of the frontal lobe together with the augmented prominence of Broca's area of speech is doubtless indicative of a human being endowed with better linguistic abilities, broader capacities for experience, and improved reasoning powers. There is little to denote expansion in the motor area or in the intermediate precentral area for skilled movements. One clue to the probable extensions in these important regions is furnished, however, by the parietal lobe, which now may be considered.

Parietal Lobe.—Although it lacks any impressions of fissures or convolutions, the parietal lobe evidently has increased in size. This is especially noticeable in the parietal eminence, and in the prominence of the arc of the vertex. Both of these increments signify accessions to general body sense and are incident to specific expansions in the area pertaining to the upper extremity, more especially the hand. Such augmentation of the parietal lobe justifies the interpretation of further extension in manual attainments. There is reason to believe that the Dawn Man had acquired increased capacity in the use of his hand as a sensory organ. He could employ it to much advantage in exploring the world about him, and in analyzing the objects in his environment by actual contact with them. Thus he learned the consistency, the shape and the texture of things he touched. The weight and mobility of objects gave him added information concerning their utility and application. The relative resistance of wood and stone, their respective projectile and penetrating powers, the advantages of sharp edges as compared with blunt surfaces, the pliability of flexible substances, the tensile strength of various tissues, all came to him as revelations called forth by these new perceptions of the world. Such revelation did not limit itself to mere sensing. The sensory impressions found externalization in new actions. They doubtless guided his hand to utilize the serviceable qualities of objects with which nature surrounded him. In a word, they led him to make use of stick and stone, from which advance it was only a step to fashion his materials into implements better suited to his purposes.

While the increase in the parietal arc and in the parietal eminence denotes new capacities of sensation, it is quite as insistent concerning the motor powers added to the human hand. There may be a question whether the earlier ape-man of Java had learned the secret of making implements for himself, but it is becoming more clear that the crude flints found in the same stratum with the Piltdown skull were the production of human skill. These eoliths have occasioned much debate concerning their "humanity." If it should be decided at length that they did not form a part of the Dawn Man's equipment, the development of his brain does not gainsay his ability to manufacture or use such implements. This is all the more true since the slightly larger size of his left hemisphere plainly suggests unidexterity. The chipping of flint instruments, above all other activities, would require such a modification in his manual organization that one hand served to hold and the other to shape the flint.

To explain the increased dimensions characteristic of the Piltdown brain, it seems necessary to presume that this race had made certain adaptations that called for added neural capacities. In all the varied adaptive radiations seen in other mammals, there is not any demand for complex adjustments comparable to that affecting mankind. Search as one may among all these variations, one does not find any influence, any single factor that is so compelling of cerebral specialization as the development of the human hand. By this means an entirely new world had been laid open for man to conquer, and a still newer one waited for him to construct. So it was that a brain sufficient for the simple living in plain and forest could not serve this new mastery of life any longer.

The parietal lobe, although it primarily represents administration in one of the chief departments of the sensorium, also expresses the externalizing capacity of the brain. This is true to a somewhat less extent of the other cerebral lobes representing the special senses.

Temporal and Occipital Lobes.—These likewise reveal a marked advance. The casts of the Piltdown endocranium are fortunate in showing most of the left temporal lobe. The reconstruction of Dr. Woodward differs from that of Sir Arthur Keith in disclosing little of the superior temporal convolution. Keith believes that his reproduction is in better accord with the conditions of human anatomy. His cast also obviates the marked deflection inward of the tip of this lobe and thus gives it a less simian appearance. Large portions of the middle and inferior temporal convolutions are clearly delineated, together with a part of the temporosphenoidal surface of this lobe. Both casts show a pronounced increase in the auditory eminence as compared with pithecanthropus. This eminence is situated at the base of the temporal lobe where

the latter comes into relation with the occipitoparietal area. It represents a cortical region engaged in the sense of hearing, more particularly for complex sounds, such as those of language. In this capacity it acts as a most important component of the mechanism of speech. Not only does it make possible the learning of language, but also through motor reproduction of what is previously heard, it provides a constant auditory supervision over language as it is vocalized in audible speech. The individual possessed of articulate expression "listens in," so to speak, while he is talking. If it is true that thought depends on unspoken language, the auditory area of the brain exerts a profound influence over the process of thinking. The Dawn Man, on the strength of these facts, must have been capable of some kind of spoken language just as he was possessed of some capacity for thought.

Little of the occipital lobe is available for study. It is difficult to determine whether the Piltdown man had better visual powers than his lower antecedents. Improvement, if there were such, involved his visuopsychic functions, i. e., the visual powers of association and discrimination.

Comment.—Thus visualized through the development of his brain, the Dawn Man may appear a somewhat uncertain member of the human family. Doubtless he lived in communities of considerable size, for else his powers of vocal communication would have had little opportunity to develop. He seems to have been capable of many skilled acts, but such implements as he did make were probably dictated by the bare essentials of life, by the need for food and for protection. It is probable that none of his instruments served for cultivating the soil or for the production of garments or the construction of permanent dwellings. He was dependent for his livelihood on game which he followed in their migrations and thus himself became a wanderer. What powers of thought he had or what gifts of imagination are matters for conjecture. Nothing remains from which to surmise his actual customs or to suggest his attitudes toward the world as he did or did not understand it. Sir Arthur Keith says that "A survey of the convolutionary regions of the brain leads to the conclusion that we are dealing here with a simple and primitive arrangement of parts; but not so simple or so primitive as to make us wish to place the Piltdown brain in a class apart from modern human brains."

The Dawn Man, as his brain attests, had come a long distance from that parting of the ways at which the human and anthropoid stocks separated. But it is equally certain that there remained a great distance yet to be traversed before such a brain could attain the development characteristic of the modern human cerebrum.

THE BRAIN OF NEANDERTHAL MAN,
HOMO PRIMIGENIUS

Eoanthropus, as his name implies, is presumed to mark the dawn of mankind. But the full day of human existence was long in coming. Ages passed during which it seems certain that several different races of primitive men made their appearance only to die out again. It is remarkable what slight traces of their actual image these earliest inhabitants of Europe have left. There is, however, reliable evidence of at least one such race of prehistoric Europeans, the Neanderthals (figs. 10 and 11). From their scattered fossil remains they appear to have possessed many features in common. They were relatively short in stature, probably not averaging much more than 5 feet 3 inches in height. Their limbs were powerful, their necks short and extremely muscular. What distinguished them as a race was the shape of their heads and size of their brains. The Neanderthal cranium shows a low retreating forehead and a peculiarly low dome. The head seems flattened from above downward, giving the appearance known as platycephaly (flat head). The occipital as well as the frontal portion of the skull is affected by this flattening, so that the head must have been supported by a thick powerful neck, similar to the gorilla. Even more conspicuous is the heavy ridge of bone above the orbits, the supra-orbital torus, which produces the facial aspect familiar in the "fighting mask" of the great apes (chimpanzee and gorilla). The orbits themselves were larger than in modern man and were separated by an anterior narial opening that indicates the presence of a broad, flat nose. The lower jaw was heavier and broader than in *Homo sapiens*, although the teeth as a whole were strikingly human, having none of the fang-like specialization of the great anthropoids. On the mandible, in the region of the chin, a mental eminence, was not present. All of these cranial characters must have given the Neanderthal man a singularly gorilloid appearance. The low beetling brow, the flattened vault of the skull, the head set close on the shoulders, the broad flat nose, the heavy jaw and the receding chin could hardly fail to produce a countenance in many respects as brute-like as the great anthropoid apes. Envisaged from his fossil remains, Neanderthal man was indeed a savage looking creature. But his brain is not altogether in keeping with this low estimate of him. In fact, the volume of the Neanderthal brain is somewhat greater than that of modern races. This cerebrum does not denote such low psychic organization as the ape-like appearance of the head would seem to suggest.

Neanderthal man had made definite advances in human progress. He laid the foundation of many customs and tendencies that later dominated social organization. He was a skilled artisan and flint-worker. He had command of fire, which he employed both as an invaluable accessory to his life and in the upbuilding of distinctive cultural attainments. He

buried his dead with ceremonial rites which shows at once that he believed in a future existence and possessed some religious conceptions. Far from being a lowly apelike creature, he had many of the higher attributes of man. Although the Neanderthal had a decidedly pithecoïd cast of countenance, he displayed human ability not to be despised. For this reason he is known as *Homo primigenius*. Yet his apelike affiliations, in spite of his human intelligence, make it probable that he was not the direct ancestor of modern man.

The fossil remains of the Neanderthal race have been found widely scattered throughout Europe, in France, Belgium, Germany, Moravia, Croatia and even in the island of Jersey. The earliest discovery of this race dates back to 1848, when the Gibraltar skull was found by Lieutenant Flint. The significance of this find, however, was not fully



Fig. 10

Fig. 10.—Endocranial cast of Neanderthal man (La Chapelle aux Saints) showing lateral view of right hemisphere.



Fig. 11

Fig. 11.—Endocranial cast of Neanderthal man (La Chapelle aux Saints) showing the impression of the superior surface of the brain.

appreciated for more than sixty years. Neanderthal fossils comprise a collection of skulls, skeletons, mandibles and teeth—in total, a remarkably large number of fossilized parts—from which the osseous appearance of the race has been determined beyond all doubt. Of the skulls only four served the purposes of exact endocranial study, such others as are known being too fragmentary or too greatly damaged to permit of more precise deductions.

In the valley of the Dordogne, Southwestern France, the abbés Bonyssionie and Bardon (autumn, 1908) discovered the skeleton of a primitive man in a cavern near the little village of La Chapelle aux Saints. The body rested on its back with its head toward the west, its legs, thighs and forearms flexed. The head had been especially protected

by flat stones, and many skilfully worked flints of the Mousterian period surrounded the skeleton. There was every evidence of burial and burial ceremony about this discovery. Professor Boule of the National Museum of Natural History in Paris concluded that the skeleton was that of a man of about middle age, belonging to the Neanderthal race. In its dimensions the skull exceeds those of an average modern man, having the exceptional capacity of 1,600 cc., which is at least 120 cc. above the modern average. But the skull was distinctly low vaulted and had an apelike supra-orbital torus with low receding brow. The endocranial cast of the La Chapelle man serves especially well to give an accurate view of the Neanderthal brain.

Figures 10 and 11 show those features which might be presumed from the Neanderthal skull. The shape of the brain is distinctly flat. That arching in the region of the vertex so prominent in *Homo sapiens* and at least slightly foreshadowed in the brain of pithecanthropus, as well as in the Dawn Man of Piltdown, is remarkably absent. In a portion of this arc that affects the prefrontal region, the curve actually seems to sink inward. When one makes all proper allowances for discrepancy in reconstruction, it is nevertheless certain that the vertical areas of this brain have adapted themselves to a flattened head. This observation is particularly pertinent from the fact that it is the brain which in the main appears to determine the shape of the skull. Doubtless there is an interplay of factors in this growth relation, but the cerebrum is the essential organ of the cranium, and its developmental demands are of chief moment during the important formative period. It is the shape of the brain rather than the shape of the head that may be considered a determining character in the Neanderthal race. In its shape this brain is far from apelike. It bears all the marks and features of the human cerebrum.

Certain intrinsic factors in cerebral development may conceivably be related to the flatness of the brain of the Neanderthal. Thus, for example, the ventral horn and body of the lateral ventricle may be less capacious, the rhinencephalon (olfactory brain) may be more expansive, the corpus callosum less well developed, or the centrum ovale contain less medullary substance. Such modifications in the normal process of growth of the brain might contribute to cerebral flattening or broadening. But none of these purely conjectural possibilities seems so likely to influence development as the salient factor which plainly declares itself on the surface of the Neanderthal brain.

Compared with the ape-man of Java, as well as with the Dawn Man, the Neanderthal possessed a brain that showed expansion in all its major divisions. The parietal, occipital and temporal lobes all have increased in size. So also has the frontal lobe, but the ratio of its expansion appears to be less than in the other areas. In this region the

real flatness of the brain is most pronounced. Not only have the frontal convolutions on the convexity failed to give the forebrain those dominant characters which call forth the high, wide forehead of modern man, but also the representation of the frontal lobe on the mesial surface appears to have remained in its more primitive state. Certain secondary effects leading to the flattened aspect of the brain would of necessity follow in this connection, and emphasize still further the low vaulting of the brain. A lagging development in the frontal lobe would determine a centrum ovale of relatively small dimensions because of smaller fiber contributions from the corpus callosum and from adjacent association areas. The caput and body of the corpus callosum would in consequence be smaller and would thus fail to furnish that fractional increment which gives the complete fullness to the frontal arc in *Homo sapiens*. This apparent failure of the Neanderthal frontal lobe to attain its ultimate proportions not only characterizes the organ from a structural point of view, but also must have had a far reaching influence on the ethnical culture and final destiny of these primitive Europeans.

The position of the sylvian fissure is readily identified in its posterior division extending from the frontotemporal notch beneath and caudal to the parietal eminence. The arrangement of its caudal extremity is not discernible, but its anterior and horizontal rami are clearly defined.

The fissure of Rolando may be introduced on the basis of the usual estimations for this sulcus. Its exact position, length, angle of inclination, and terminations are mainly hypothetical, since the presence of the fissure is not indicated by any actual groove on the cast.

The groove of the transverse sinus is visible and marks the division between cerebral hemispheres and cerebellum.

Frontal Lobe.—This lobe as a whole bears evidence of much expansion as shown by the broadening of its pole and a tendency to round out the arc which gives the identifying prominence to the modern forehead. The process, however, involves only the polar areas of the lobe in which the impressions of the superior and middle frontal convolutions are apparent. In the remainder of the frontal area there is not any sign of fissures or convolutions. The exact allocation of the precentral motor area or of the intermediate precentral area for skilled movements cannot be made. The coronal constriction is conspicuous. A large pacchionian elevation is situated near the superior longitudinal fissure in the line of the coronal suture. On the right hemisphere the position of the middle meningeal artery is faintly visible, while on the left it is less distinct. The outstanding feature of the frontal lobe is the prominence of the inferior frontal convolution. This gyre on the left side is more complex in its arrangement than it is in either the Javan or Piltown man. In it may be recognized the pars orbitalis, the pars triangularis and the pars

basalis, all characteristic features of Broca's area of speech in *Homo sapiens* (fig. 12).

Such frontal development is indicative of psychic powers beyond the still more primitive races of man and also of a capacity for speech that seems to be approaching modern standards. Neanderthal man possessed a degree of reasoning ability and judgment which he doubtless applied with advantage to the organization of his efforts and the regulation of life. His acknowledged capacity for speech shows that his was not an existence of isolation but rather that the economic value of communal living had been appreciated and utilized. His advances in the mastery of his environment may be understood from the better development of his frontal lobe. He had come to recognize some of the elements of human superiority as compared with other living creatures. In his contests with the beasts of prey he had gained a certain degree of ascendancy, enough, at least in his later cultural periods, to dispossess his carnivorous

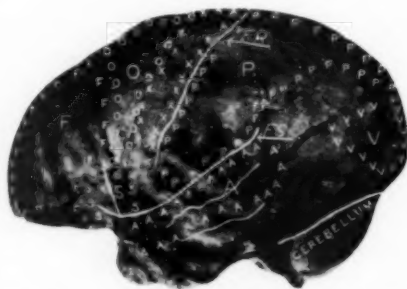


Fig. 12.—Functional localization outlined on the surface of the left hemisphere in Neanderthal man (La Chapelle aux Saints).

enemies from their caverns. These shelters he took over for his own abodes and thus gave the embryonic sense of ownership a new impetus. He buried his dead in a manner showing belief in a life hereafter. In such customs as these he revealed not only a fertile imagination, but also that pervasive conception which in time created an egoistic superiority deemed worthy of perpetuation after death. Yet, even with all these human advances, his frontal proficiencies left something to be desired. He lived and prospered for vast periods of time, but he failed to develop those qualities which guaranteed his kind terrestrial permanence. At length another race invaded his dominions and the Neanderthal, doubtless not without a struggle, disappeared before these new people. That he was unable to cope with the invaders bespeaks some serious omission in his frontal development, an omission that the newcomers already had overcome. Defensive cooperation on a large scale, essential to successful military puissance, may well have failed the Neanderthals in their time of need. Their eventual establishment of

habits incident to cave dwelling committed them to a program of simple communal life. They were hunters and nomads first of all, and tenants only by late acquisition. Their chief interest was the quest of game. Nothing in their antiquary relics shows that they possessed an equipment or organization suited to effective warfare. Thus their deficiencies must have been in those departments of neural development on which higher social efficiency depends. Failing in these attributes, they at length fell victims to those who had, through better brain power, especially in the frontal lobe, already attained such advantages.

Parietal Lobe.—This yields little evidence of its intimate details. There are not any signs of fissures or convolutions. In the cast, this entire lobe indicates much expansion, and it seems probable that in this area the Neanderthal brain has made its greatest advances. The parietal eminence is particularly prominent, and its general position denotes a region especially involved in the receipt of sensory impressions from the upper extremity. The boundaries of the lobe, with the exception of the sylvian fissure, are indefinite. No clue with reference to the size and complexity of the postcentral and precentral convolutions is obtainable. The estimated dimensions of the parietal lobe together with the marked prominence of the parietal eminence are, however, significant. The Neanderthal brain possessed a somesthetic capacity nearly equal to that of modern man, and its principal specialization involves the area pertaining to the hand. Such increment in sensibility connotes a corresponding expansion in motor capacity. It is not giving undue stress to this sensory development, perhaps, to maintain that Neanderthal man had made better contacts with his surroundings and had gained greater mastery over all that his hand could touch. New combinations and modifications of objects fashioned by his hands began to yield him a rich harvest of new utilities. He was beginning to take a more dominant part in creation, and not the least of the factors contributing to his increasing power was the parietal lobe of the brain.

Temporal and Occipital Lobes.—Both show expansion. It is obvious that the temporal lobe has lost most of that highly simian appearance occasioned by the inward deflection of its tip. It is, in fact, as large and nearly as well developed as the temporal lobe of modern races. A long palpable groove marking the fissure of Sylvius separates the temporal from the parietal area. A lesser groove parallel to the first indicates the position of the superior temporal fissure, while a short indenture localizes the middle temporal fissure. The greater portion of the temporosphenoidal surface is retained in the reproduction of both temporal lobes. The convolutions on the lateral and basal aspects are well marked, giving the impression of a cerebral territory of well developed functional capacity. More convincing is the large size of the auditory eminence situated at the confluence of temporal, parietal


and occipital areas. This eminence is generally accepted as part of the mechanism of speech, being especially assigned to those auditory functions inherent in spoken language. Judged by this criterion in relation to Broca's area, the Neanderthal race possessed linguistic capabilities not far below the standards of *Homo sapiens*.

The occipital lobe also shows the effects of extensive additions. Visual function, and particularly visuopsychic function, has been greatly expanded as compared with more primitive man. The occipital pole, as in modern races, extends considerably beyond the tentorial surface of the cerebellum. The impression of the lambdoid suture crosses this lobe transversely near its junction with the parietal area. At least one fissure, the transverse occipital sulcus, marks the lobe and separates two occipital convolutions. The lobe as a structural entity has assumed much more individuality than it has in the brains of lower races. It denotes a neural organization suited to more extensive visual perception and appreciation. Furthermore, it signifies the increment possessed by Neanderthal man for the visual guidance of highly organized manual skill.

Comment.—Two other endocranial casts of the Neanderthal race should be placed in comparison with the La Chapelle aux Saints specimen. Both of these skulls are smaller and are attributed to Neanderthal women.

The La Quina skull was discovered by Dr. Henri Martin in 1911, together with other portions of the skeleton. The brain capacity estimated by Professor Anthony at 1,350 cc. is 250 cc. less than that of the Neanderthal man of La Chapelle, but corresponds with other females of the race found at Gibraltar and Croatia. The cast is remarkable in two respects: it duplicates all the cranial characters of the La Chapelle specimen with a faithfulness that compels conviction. It is, in addition, a notable example of endocranial casting. The Neanderthal peculiarities of cerebral configuration are most pronounced, as already observed, in the frontal region. Here the same sharp elevation (at about 90 degrees with the base) occurs above the supra-orbital torus. It extends only a short distance and quickly falls away into the flattened arc that adapts itself to the low receding forehead. Nor is this arc consistently maintained. As in the La Chapelle cast, it sinks into an actual concavity near the plane of the coronal constriction. The entire brain seems flat, partially in response to the disposition of the frontal arc but also because of pronounced broadening in the parietal region.

The frontal lobe near its pole shows the superior and middle frontal convolutions, but beyond this area there are not any indications of sulci or gyres. The inferior frontal convolution is prominent in both hemispheres. In it may be discerned the ascending and horizontal rami of the sylvian fissure especially well marked on the left side. The parietal



and auditory eminences are both prominent, while the occipital lobe, which overhangs the cerebellum, contains markings of the transverse occipital sulcus and the corresponding convolutions. The groove of the posterior ramus of the sylvian fissure is palpable beneath the parietal eminence. Some of the temporal lobe may be defined on the lateral and temporosphenoidal aspects, but the outlines are less clear than in the La Chapelle cast.

The imprints of the coronal, lambdoid and sagittal sutures are particularly distinct. The course of the middle meningeal and its main branches may be easily traced, although the relief is not pronounced.

The Gibraltar skull, although of greatest historic importance, does less to further the knowledge of the Neanderthal brain than those discussed in the preceding descriptions. It holds its place as the premier discovery related to the existence of this race of man. A considerable portion of the skull is missing but its actual fragments, together with the endocranial reconstruction by Professor MacGregor, declare its Neanderthal characters. The frontal arc manifests its several typical components making the fact certain that the brain belonged to an individual with a low receding forehead and a marked supra-orbital torus. Frontal convolutions are somewhat imperfectly reproduced because of erosion in the inner table of the cranium. The parietal and auditory eminences and the occipital and temporal lobes all present Neanderthal appearances. From the purely structural point of view, the Gibraltar skull has its chief importance because it has preserved so much of the cranial base. This is a detail almost wholly missing in the other specimens. In the frontal region of the basal surface, the orbital concavities are deep and much more simian than in modern races. The interorbital keels are prominent. Both of these conspicuously simian features are associated with the large orbits of the Neanderthal. The middle fossa contains the large temporal lobes, and an ample opticopeduncular space. The mesial surface of the temporal lobe, near its apex, shows a well developed uncus. The portion of the brain in contact with the middle fossa and such parts as are preserved in relation to the posterior cranial fossa are much more human in character than the areas of the brain related to the anterior fossa. This condition of affairs is remarkable and worthy of some comment. In the frontal region of the Neanderthal cranium, it is apparent that certain anthropoid tendencies have had the upper hand. The capacious orbits, the heavy supra-orbital torus, the low receding brow and the broad anterior narial opening impart a definitely gorilla-like appearance to the head and face. But back of all this is a region of the brain which still retains many resemblances to the great apes. Thus, the orbital concavities, the supra-orbital keels and the flattened frontal arc are reminiscent of gorilla and chimpanzee. In this light, it might seem that the Neanderthal brain was not yet highly human.

It had made certain great strides in this direction, but mere increase in volume, pronounced though it may be, is not sufficient to produce the cerebral characters of the fully developed human species. One indispensable item must still be added to complete the stature of man. The frontal lobe should acquire all of those characters peculiar to *Homo sapiens*. A brain not so developed does not attain its full human measure. In such development cerebral growth is dominant. As the brain grows, the orbital plates flatten and the supra-orbital torus recedes. In the end the pithecoïd visage gradually fades until it loses its brute-like features. It does so because the frontal lobes of the brain, those last gifts of evolutionary progression, have enlarged and thus have compelled the humanity of man to appear in his face and head. Such a view seems also to reconcile the perplexing discrepancy between the apelike head and manlike brain of the Neanderthal. It shows that these parts of

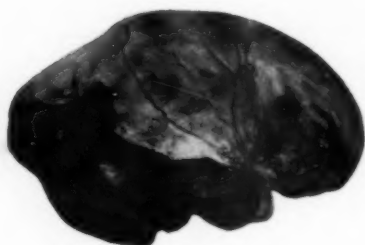


Fig. 13

Fig. 13.—Endocranial cast of Rhodesian man showing lateral view of right hemisphere. The heavily shaded area shows the limits of the cranial fossil.



Fig. 14

Fig. 14.—Endocranial cast of Rhodesian showing the impression of the superior surface of the brain.

the body are actually in harmony with one another. It may even offer the explanation why the Neanderthal race progressed so slowly during the passage of more than 100,000 years and at length was completely replaced by a more exalted type of man possessed of well developed frontal lobes. The cultural phases attributed to the Neanderthals include their feeble beginnings in the Chellian period, their advances in manual dexterity to the Acheulian era, and their culminating refinements in design and execution during the Mousterian period. But these people began as nomadic hunters and so, with slight and perhaps incidental modifications, they ended. Succumbing to the invasion of the more effective Cro-Magnons, they did not leave any trace of themselves among this greater race. Such complete disappearance without evidence

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of that interbreeding common between victors and vanquished also may be the result of the Neanderthal's apelike specializations. Racial discrimination on the basis of such wide morphologic differences would tend more toward the extermination of the inferior race than to its subjugation.

THE BRAIN OF HOMO RHODESIENSIS

Asia and Europe have both produced evidence of prehistoric man, the latter most abundantly. Until recently Africa has been peculiarly silent in this regard. But at length even the Dark Continent has revealed signs which show that man of a most primitive type had penetrated a long way into the south during his wanderings over the earth. This important discovery was made in Rhodesia and was first publicly reported in 1921 by Mr. William L. Harris¹ (figs. 13 and 14). The conditions under which the discovery was made were peculiar and significant. Actual remains of two human skeletons were found at Broken Hill Mine, in Northern Rhodesia. These remains differed from similar fossil discoveries in one essential detail. They were not fossilized in the ordinary sense. Connected with the Broken Hill Mine there was originally a natural cave about 120 feet long. This was known as the "Bone Cave" because it contained a vast number of animal bones all of which were so thoroughly impregnated with salts of zinc and lead as to make smelting of them worth while. At the bottom of this cave the human remains were found. Like all of the other bones in this enormous osseous deposit, the surfaces of the human skeletons were incrustated by zinc and lead so that the action of the earth had failed to mineralize the deeper bony tissue. Paleontologists accept such remains as "fossils," but unfortunately this surface incrustation precludes any estimation of the geologic age of the bones. Unfortunate also is the fact that the osseous remains of animals found with the human skeletons were all of species still extant in Africa. The cave seems to have been an ancient feasting place for hyenas which dragged thither their prey. There is even some remote suspicion that the human remains may have come to their last resting place in the Bone Cave in such a manner. A cleft in the roof of the cave near its far end, where a human skull was discovered, suggests the possibility that the men or women whose bones were found may have fallen into the cavern in relatively recent times. Three important details usually helpful in the chronologic assignment of human fossils were wanting in connection with these Rhodesian relics: (1) the actual fossilization of the bones; (2) the presence of extinct mammals or other animals; (3) the existence of stratigraphic identifications. No inference may be drawn concerning the exact nature of this human depository. It may have been either accidental or the result of a burial ceremony. Further-

1. Harris, W. L.: Sunday Times, Johannesburg, Sept. 25, 1921.

more, little evidence such as the collateral discovery of paleolithic implements may be adduced to shed light on the antiquity of Rhodesian Man. Yet, certain features, especially of the skull, have convinced eminent authorities of the great age and specificity of this race. Elliot Smith, for example, believes that the Rhodesian man is "a long lost and strangely exotic cousin" of the human family circle. He bases his opinion on the striking peculiarities of the Rhodesian face which he calls the most primitive in all the genus *Homo*. This face is also more brutal than that of any known human being, living or extinct. Its enormous eyebrow ridges are bigger even than those of the most archaic human, the Javan ape-man, and recall the conditions seen in gorilla. There is no indication of a groove at the side of the nose marking the boundary between it and the face, such as is constant in all races of modern man, even in the Negro, Mongol and Australian types. The merging of the nose with the face to form what in other animals is called a snout and regarded as a peculiarly significant mark of the beast is known only in one other extinct member of the human family, i. e., Neanderthal man. But the Rhodesian's nose is even more apelike than that of the Neanderthal. Another remarkable feature of the facial skeleton is the great size of the palate and teeth, although the canines do not project in the characteristic simian manner as in the Dawn Man of Piltdown or the fossilized proto-Australian of Talgai. The form of the brain case and the distinctive features of the brain alike corroborate the inferences drawn from the face which declare the Rhodesian species the most primitive of the entire genus *Homo*, older and more primitive in fact than Neanderthal man. The shin bone and fragment of the femur support this estimation of Rhodesian antiquity. Such is Elliott Smith's view concerning the age of this last discovered member of the human race. There is, he admits, much that is tentative about his present opinion. The Rhodesian fossils are now in charge of Dr. Smith Woodward in the Natural History Department of the British Museum at South Kensington. Dr. Woodward has already expressed his view that *Homo rhodesiensis* represents a phase of evolution later than the Neanderthal type. Doubtless in due time a more intensive study of these fossil remains will give a greater degree of finality concerning the antiquity of this race of primitive men.

The endocranial cast of the Rhodesian skull presents certain interesting and at the same time perplexing features. At first glance it seems to conform in type with *Homo sapiens*. Closer inspection, however, occasions considerable doubt in this regard. On the other hand, the Rhodesian brain appears much superior to that of either the Javan or Piltdown man. It is more primitive in some particulars than the Neanderthal cerebrum. Its volume is slightly larger than that of the Piltdown brain, but distinctly smaller than the Neanderthal. It has

much less of the flattening in the frontal arc than is true of *pithecanthropus*, *coanthropus* or *Homo primigenius*. In a word, it would be difficult to associate this brain genetically with that of any of the primitive races already considered. It is nevertheless too small and too little specialized in certain areas to consider it in close relation to *Homo sapiens*. For the present it seems desirable to regard this specimen as representing a distinct race whose affinities and antiquity may be estimated in the most general terms only.

The sylvian fissure may be located without difficulty by the deep groove starting at the temporofrontal notch and extending backward beneath the parietal eminence. The fissure of Rolando has been introduced in the cast by utilizing the usual formula for this sulcus. The groove of the transverse sinus is well defined as are also the ridges marking the distribution of the middle meningeal arteries of the right and left hemispheres. With the recognition of such landmarks it is possible to identify the boundaries of the major lobes on the convexity of the hemisphere, although actual limits may not be defined between the occipital and parietal areas.

Frontal Lobe.—This shows a notable absence of convolutional impressions. This is particularly true of the prefrontal area, in which the polar extremities of the middle and superior frontal convolutions are usually well marked. A pronounced ridge indicates the position of the coronal suture in the immediate vicinity of which are two prominent pacchionian elevations, one on either side of the sagittal line. The frontal arc is higher than in Neanderthal man and suggests a more modern type of forehead. It does not present any tendency toward concavity in its entire extent. The frontal and intermediate precentral areas, on the other hand, show a distinct flatness indicative of a relatively incomplete development in the two regions. Two distinct areas of compression appear in relation to the sagittal sinus on either side of the coronal ridge. These are the flattened regions referred to as indicating a lack of fulness in the frontal contour. They are symmetrical in the two hemispheres and for this reason are less likely to be in the nature of artefacts. The more anterior of the two depressions is included in a well defined coronal constriction. There is no surface feature to denote a particular prominence of the precentral convolution nor of the intermediate precentral area of skilled movements. The inferior frontal convolution, however, is a conspicuous feature of the frontal lobe. It shows a considerable degree of specialization on the left side in which the horizontal ramus of the sylvian fissure may be discerned. The development of this convolution on the right side is almost as much advanced. The basal surface of the frontal lobe confirms the impression that this is a primitive type of cerebral organization. The orbital cavities have a simian depth, and the interorbital keels are correspond-

ingly pronounced. The imprint of the orbital convolutions is unusually prominent. In character they resemble these structures in the human brain.

By all the signs of his frontal lobe, Rhodesian Man must have been a humble sort of human. Nothing in this region of his brain denotes any approach to the attainments of *Homo sapiens*. The frontal area bears many marks of his simian retentions, although it also shows that his cerebral capacities had already transcended the anthropoid limits and were fast carrying him toward broader plains of human experience. It would be surprising, however, to find him capable of any advanced handicraft or productive of any such culture as characterized the Neanderthal even in his early periods of progress. His must have been a precarious lot, pitted as he was against the formidable mammals of the African wild. Even in this jeopardy, his brain had not left him entirely destitute for the exigencies of such competition. A more facile

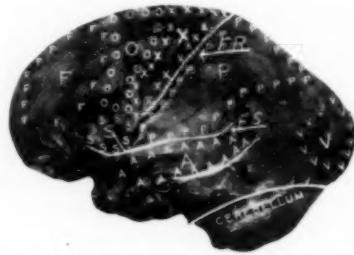


Fig. 15.—Functional localization outlined on the surface of the left hemisphere in Rhodesian cast.

association of ideas brought greater wariness to increase his contrivances and to amplify his strategies. He began to have a real panoramic continuity in his apperceptive life. Past experience formed the conscious background of his daily existence and entered into his plans for the future. If such advances as these may be attributed reasonably to his frontal lobe, there is evidence of a still greater advantage possessed by Rhodesian Man by virtue of development in this region of his brain. His Broca's area indicates that he had acquired the powers of speech. Cooperative preparation and combined effort were thus made possible. The experience not of one but of many created organizations of strength that were more than a match for the most dangerous of his adversaries (fig. 15).

Parietal, Temporal and Occipital Lobes.—These lobes indicate the extremely primitive status of the Rhodesian brain. The marked flatness which characterizes the area of the superior parietal gyrus is especially striking and significant. This region represents a functional area in which the higher elaborations of body sense are administered. Such

complex sensory combinations as those concerned with stereognosis (the recognition of the form and character of objects by palpation) and acrognosis (the proper sensing of positions and movements of the limbs) are assigned to this part of the cortex. Here also kinesthetic sensibility has important representation. All of these sensory components are essential to the upbuilding of the motor syntheses of skilled movements. These neopallial areas not only provide for effective sensing of the environment by contacts with the body, but furnish the fundamental elements by which the most complex motor adjustments are learned and controlled. Judged by his parietal lobe, Rhodesian man had not attained a high standard of skill, and this applies particularly to his manual dexterity. He was probably not an efficient artisan, nor did he possess as wide a range of motor adaptability as the Neanderthal race. The relatively low relief of the parietal eminence is another indication of deficient development in his parietal lobe.

The temporal lobe is even more insistent as to the comparative inferiority of cerebral development in the Rhodesian. In fact, there is much about this region of the brain to suggest the possibility of pathologic retardation in growth. This is more particularly the case in regard to the temporosphenoidal surface, although the temporal lobe as a whole is remarkably small. The auditory eminence shares in this limited development. The tips of the temporal lobes are not only unusually small, but are symmetrically deflected inward in a manner similar to simian conditions. As an index of cerebral capacity this area of the brain discloses a marked inferiority in auditory function, especially in those elements participating in the mechanism of speech. The spoken language of Rhodesian man had at best only a meager structural substratum and was for this reason, undoubtedly, crude as compared with Neanderthal speech. The composite parietotemporo-occipital area is distinctly abbreviated—indeed, appears as if compressed. Whatever neural combinations were dependent on this neopallial zone must have had their decided limitations.

The occipital lobe, in that portion of it representing visuopsychic function, is remarkably well developed. It is crossed by the ridge of the lambdoid suture and has a well defined sulcus lunatus extending over each occipital pole. The convolutions above and below this sulcus have a clear outline. Contrary to the status in all other parts of the Rhodesian brain, the occipital lobe denotes a marked progressive advance toward *Homo sapiens*. One appearance in this region of the brain emphasizes the size of the occipital lobe, namely, the smallness of the cerebellar hemispheres. This fact introduces the disturbing contingency that the condition may be the result of congenital cerebellar smallness or atrophy. Such a suggestion of pathologic change in this brain should be mentioned only with the object of introducing all possible factors, however remote,

before final evaluation of the cerebral configuration is made. Furthermore, the occipital surface of the cerebellum presents an unusual obliquity indicating an angulation of the supra-occipital and basi-occipital portions of the occipital bone which is somewhat in excess of the human average. This suggestion of a possible pathologic process as explanatory of the general smallness of the Rhodesian brain might carry more weight if it were not for the remarkable facial skeleton and cranium associated with it. The heavy supra-orbital torus, the capacious orbits, the wide anterior narial aperture, the broad palate, and the limited cranial capacity are all so thoroughly apelike as to signify a structural inferiority along pithecoïd lines which could not be reconciled with a large brain of advanced human type. The cerebrum of *Homo rhodesiensis* is small, therefore, because it belonged to a man who,

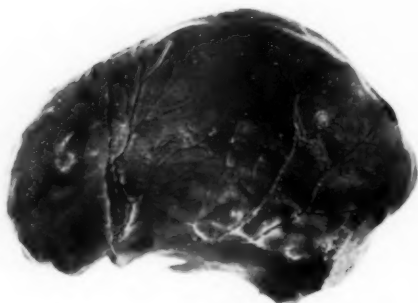


Fig. 16

Fig. 16.—Endocranial cast of Predmost showing lateral view of left hemisphere. The irregular line near the base indicates the lower limits of the cranial fossil.



Fig. 17

Fig. 17.—Endocranial cast of Predmost man showing the impression of the superior surface of the brain.

although already human, had progressed only a short distance toward the ultimate goal and standards of humanity. Elliott Smith has established a strong case for the great antiquity of this "strangely exotic cousin" of our family circle. It seems wisest, for the time at least, to accept his judgment that Rhodesian man occupies a far more primitive place in human evolution than any of the Neanderthals.

BRAIN OF THE PREDMOST MAN

It would be particularly illuminating if the brain of the great Cro-Magnon race were available for study. These people occupied an exalted position, even as the earliest representatives of *Homo sapiens*,

and the record of their remarkable existence should be correspondingly complete. But in lieu of any survey of the cerebrum of this race, it is necessary to draw analogies from certain of their human contemporaries who lived in middle Europe during Solutrean times. These others were a remarkable people also. They are known as the great mammoth hunters of Predmost, whose social affiliations ally them closely to the Brünn race. The remains of these men of the Old Stone Age were found in Moravia (figs. 16 and 17). Associated with them were the fossilized bones of nearly nine hundred specimens of mammoths. In addition to these fossils of men and beasts there were many highly worked flints including spear heads of the laurel leaf type, a pattern that marked this industry as that of the Solutrean era. At Predmost, where Maska discovered a collective burial of fourteen human beings, there were also the remains of six others. In stature, these people must have belonged to a large and powerful race. Their prowess as trackers of great game was exceptional, judged by the fossils of the huge mammals among which they reposed. This fact gave them the name of "Mammoth Hunters." But it is the reproduction of their cerebral characters that raises them at once to a plane higher than any of the earlier races of man; in fact, it places them definitely in the category of *Homo sapiens*. These intrepid hunters had much in common with the Brünn race, much indeed that resembled their splendid contemporaries of western Europe, the Cro-Magnons. Of the latter there is ample record, in consequence of which they will always rank among the noblest representatives of the human species. Their remarkable artistic contribution denotes far more than the executive mastery of plastic reproduction. It signalizes that new spirit which had been breathed into mankind, that devotion to the beautiful in life which created an abiding enthusiasm in the race for all its highest ideals and loftiest purposes.

From earliest Aurignacian times this esthetic tendency was dominant. It is evident in many indications of the lavish use of personal adornment, and in the important rôle played by coiffure. The use of red and yellow ochre already was known, and it seems fair to assume that these pigments were sometimes used, much as in modern times, to beautify the body; perhaps also as tribal symbols and charms against kidnaping, or as tokens of war and mourning. That the Cro-Magnons had created some form of music seems almost certain. Their sketches of dances and masks made it probable that to vocal expression they had added artificial accessories in the shape of crude musical instruments. Their art took form in mobiliary and mural reproductions. The former included movable objects bearing ornamentation on bone, ivory, horn or stone. The latter were decorations on the walls and roofs of caverns, shelters and cliffs. Among the earliest mobiliaries are certain human statuettes and reliefs made in stone which undoubtedly represent idols.

Especially noteworthy is the collection of steatopygous feminine figures carved in soapstone of which the "Venus of Willendorf" has the greatest artistic merit. In their artistic discrimination, these Aurignacian and Solutrean sculptors showed a decided partiality for portraying women of extreme corpulence. It was, however, in the carving of animal forms that their art reached its real heights. Many living and extinct species of mammals, birds and fish thus have been immortalized. Conspicuous among the remains of the great mammoth hunters of Predmost is a rare and undecipherable engraving on ivory. It represents a much conventionalized female figure and may have been a phallic symbol, since most of the human designs of Aurignacian times manifest a disposition to exaggerate the sexual characters. Back of all this varied artistic creation, there must have been a complex and highly differentiated social organization. Only a rich human experience could provide the soil for such vivid and realistic beauty in art.

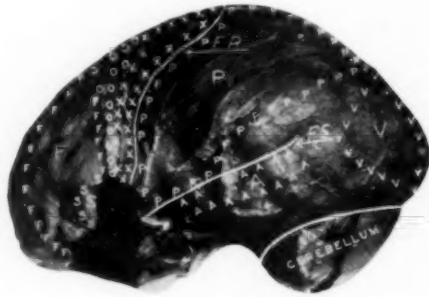


Fig. 18.—Functional localization outlined on the surface of the left hemisphere in Predmost cast.

The Predmost brain had made all of those essential advances which place it in the class of *Homo sapiens* (fig. 18). Its volume is close to the standards for modern men. It had lost the marks of inferiority which stamp the brains of lower races of man. It had gained that refinement of structural detail which proclaims the ultimate ascendancy of the human brain. The fissure of Sylvius may be identified easily and the fissure of Rolando allocated according to accepted computation. With these two boundaries in place, it is obvious at once that the Predmost brain has expanded in all of its neopallial areas. The parietal, occipital and temporal lobes alike have assumed greater proportions than in any of the earliest races of mankind. But it is in the frontal lobe that the most remarkable gains are apparent. Not only are the frontal convolutions more prominent and better defined but also that flatness so characteristic of the Neanderthal vertex has disappeared, and there is not any sign of that coronal constriction which seemed to bespeak the earliest efforts of the cerebrum in acquisition of its frontal areas.

The manner in which this evolutionary progress of the brain has gone forward is readily discerned in table 3. From the Javan man to *Homo sapiens* there has been a gradual increase in all of the major cerebral diameters. In one particular only has there been the slightest faltering in these increments. The Neanderthal brain shows the greatest transverse diameter. But its superiority in this respect is more than overcome by its marked flatness. A distinguishing metrical feature in the development of the human brain is the consistent gain in length and height from *Pithecanthropus erectus* to *Homo sapiens*. The gain in length is to be ascribed largely to frontal increments; that in height is dependent in part on parietal expansion but also to some extent on frontal accessions. The bearing of such pronounced frontal evolution on the ascent of man is evident in the progressive development of human intelligence.

TABLE 3.—Measurements of Human Endocranial Casts

Race	Width, Mm.	Length, Mm.	Height, Mm.	Encephalle Index	Cephalic Index	Volume, Cc.
<i>Homo sapiens</i> (European average)	143	195	148	73.0	....	1,400-1,500
Brunn race.....	....	....	....	....	68.2	1,350
Predmost "9".....	141	180	128	75.0	....	....
Predmost "4".....	140	187	131	74.8	....	....
<i>Homo neanderthalensis</i>						
La Chapelle aux Saints.....	146	181.5	123	80.0	25.0	1,626
Gibraltar.....	140	165	112	84.0	77.9	1,296
La Quina.....	132	171	120	78.0	....	1,367
<i>Homo rhodesiensis</i>	136	172	....	79.0	....	....
<i>Eoanthropus dawsoni</i> (Piltdown)	133	169	120	79.0	78.0	1,300?
<i>Pithecanthropus erectus</i> (Java).....	126	153	100	80.0	73.4	946

GENERAL COMMENT

Prehistoric man is gradually emerging from his long obscurity. It is now possible to discern certain attributes of his that still live and are as vital to further human progress as they were to his own day on earth. His skeletal form is known from more than 350 specimens of his fossil remains. These reveal that striking harmony of structure which pervades all human kind. But in them also may be detected many subhuman specializations and numerous variants representing, without a doubt, only a small portion of the human experimental types discarded by nature before *Homo sapiens* was at length derived.

All phases of man's earliest existence are singularly pertinent to modern thought and development. Yet the past has shut in so closely behind us that our racial consciousness is almost wholly restricted to an historic world. This scotomatous view of human existence loses sight of the preparatory biologic episodes on which our being depends.

With the appearance of prehistoric man, the curtain is lifted to reveal a human perspective of almost impenetrable depth. Looking through this long vista of time it is possible to sense, in some measure at least, the vast distance man has come since his human journeying

began: There are milestones along this course that tell of critical turnings and partings of the way. A number of these critical points are indicated by human remains. Certain prominent features of man's skeleton denote that his course did not lead in all directness to the standards of advanced human organization. Many of his osseous characters were distinctly apelike—so much so that these appearances in his earliest known state gave him the name of ape-man. It may not be denied that *pithecanthropus* had definite pithecoïd resemblances in his skull. The Dawn Man of Piltdown manifested similar tendencies less pronounced in the form of his cranium, but still clear in the fang-like character of his canine teeth. The Heidelberg jaw denotes a race in which numerous simian features were still retained, while the men of well recognized Neanderthal type also bore signs of apelike specializations in head and face. How otherwise may the massive supra-orbital ridge be interpreted, or the broad flat nose, the receding forehead, the widely separated orbits and the large palatal process of the heavy simian jaw?

Nor had Rhodesian man divested himself of these marks of the beast. With the coming of Cro-Magnon times, however, the long experimental period was drawing to its close. Man in near approach to his final modern form at length had arrived. The many details of simian resemblance were gone. The heavy characters of head and face essential to the contentious life of the great apes had similar reasons for their appearance in the earliest development of man. Judged by the formidable mammals that shared the earth with him, man's life must have been fiercely contested. The offensive equipment of his jaw and head was only feebly supplemented by instrumental devices of his own making. Increasing powers of attack required simultaneous increments of protection. The great apes, gaining in size and strength as compared with the smaller anthropoids, had, in this fact, an adequate incentive for the further fortification of their bodies and especially of their heads. The same incentive was operative in the early differentiations of man, perhaps to an even greater extent. He at least was more venturesome than the anthropoids in risking encounter with the great game animals. Some of his success in these pursuits depended on cunning, but brute force was not a negligible quality. Innumerable dangerous exposures, mollified in time by adaptive progress and various contrivances, demanded a resistant osseous structure in his cranium to protect his brain. Conditions of his lowly social organization undoubtedly augmented these traumatic contingencies. As offensive strength must have been his most effective argument, so a stout frame was his best defense. Is it entirely accurate, therefore, to speak of his bony facial mask, his heavy jaws and large teeth, his thick skull and receding forehead, as apelike specializations? Are they not the more generalized adaptive modifications shared in common by the two branches of the orthograde primate stock for a life

demanding concentrated physical force? Certain specializing factors in these two great lines of primates clearly operate in common. Such, for example, were the marked increase in body weight, the tendency to stand upright, the reduction of speed in escape, the progressive loss of arboreal retreat, the need of augmented offensive powers, and a more capable mechanism for procuring food supply. All of these appear as vital necessities in the specialization of man and the great apes. If certain structural features determined by these physiologic demands became progressively less prominent in man, it was because his genius gradually devised the means to obviate their need. In fact, it was the potential degree of cerebral growth and psychic development that kept the human cranium so plastic. It is questionable, therefore, whether any advantage is gained by the continued reference to the pithecoïd specializations of primitive man. If he were apelike in many aspects of his form and being, to offset this the great apes have been called manlike on similar grounds. This convenient interchange in terms undoubtedly signifies a mutuality in definite characteristics. On the other hand, it tends to obscure the common generic factors that imparted to man and ape alike those distinctive characters described in the human as pithecoïd.

That there was a definite prehuman stock, a stock capable of producing both anthropoid apes and man, cannot be disputed. But at least five critical and closely interdependent specializations determined the complete status of human differentiation:

The appearance (1) of the human brain, (2) of the human foot, (3) of the human hand, (4) of the erect posture with bipedal locomotion, and (5) of a terrestrial mode of life.

Once endowed with these hominid characters, the human type was irrevocably established despite such pithecoïd features as it might still retain. When this status of man is reached, however low and humble it may be, there is little justification for the term ape-man. By the very fact of this entrance into the human family, man surpassed the more narrow limitations of simian organization. At the same time he retained within himself a structural plasticity for further development, which the apes had sacrificed almost entirely to their definitive specialization.

The human race in this sense does not bear any ancestral relation to any of the known apes, either living or extinct. Man is distinguished because he was able to establish his own family in the animal kingdom by separating himself from the formal restrictions which bound the apes to their simian habitat and structure. In a recent communication, Professor Osborn² has taken a position in decisive terms which gives the human race a line of ancestors entirely its own and quite distinct from that of the anthropoid apes. "Man and all his ancestors," he writes,

2. Osborn, H. F.: *Natural History*, vol. 26, no. 3, p. 269.

"should now be embraced within the family hominidae as distinguished from the family simidae which embraces all of the anthropoid apes. This family distinction naturally carries with it the appellation 'Dawn Man' as distinguished from the appellation 'Ape-man' which will gradually disappear through disuse along with other misleading terms, due to our misconception and ignorance as to the actual ancestors of man."

Against this view it is only fair to quote the opinion of two other eminent authorities, Professor Gregory and Professor MacGregor. Both take exception to this interpretation on the ground that it may be misleading. They are generally agreed that the earliest known races of mankind were already true *Hominidae* and therefore, in spite of certain apelike features, they hardly deserve the name of ape-men. They are unwilling, however, to disclaim all kinship whatsoever of the human race with the anthropoid apes. Such kinship does not imply a direct ancestral relation but indicates an evolutionary process among the primates which places the chimpanzee and gorilla closer to man than to any tailed monkey.

The brain, in one respect, lends support to Professor Osborn's view. In the lowest known type of man, *Pithecanthropus erectus*, cerebral development had attained human proportions. The critical expansions in the frontal, parietal and temporal lobes are decisively manlike. They seem sufficient to raise the Javan man out of the class of ape-men, even if such a class eventually should maintain its validity. Furthermore, the human brain from its most humble beginning has manifested advances in specialization of those areas associated with the production of spoken language, with the regulation of highly skilled acts and, most probably at least, with unidexterity.

Thus, from its inception, the cerebrum endowed man with the capacity to develop, inculcate and transmit certain cultural activities. With the first rude fashioning of implements from stone or wood, there arose that uninterrupted stream of human achievement that has passed on as the main current of all culture and knowledge. It was this power of progressive and racial learning that made the human brain distinctive as compared with all others. Conditioned reflexes of the first, second and third order developed in many other mammals, but man soon transcended this limited conditional range. His eventual successes came from his almost unrestricted capacity to utilize the conditions imposed by his own experience or imparted to him by the didactic efforts of others. The kind of brain he possessed is apparent not only from the structure of this organ, but quite as much from his mode of life and handicraft. Viewed in the light of his many cultural phases, man's outstanding attribute has been his power to improve. From age to age, from race to race, he has shown a steady progress in the control of



Fig. 19.—The Neanderthal Flint Workers. This group of Mousterian cave dwellers is a mural painting by Charles R. Knight, made under the direction of Professor Osborn. It is arranged to show the physical characters of Neanderthal man. The knees are slightly bent, the shoulders broad and heavy, the massive head and neck well forward. The background is the famous cavern of Le Moustier which gives its name to the Mousterian period. This picture and figures 20 and 21 are taken from the "Hall of the Age of Man" in the American Museum of Natural History. Through the courtesy of Prof. Henry Fairfield Osborn.



Fig. 20.—Cro-Magnon artists painting the great mammoth fresco in the cave of Font-de-Gaume, Dordogne, France. Painted by Charles R. Knight.

material conditions as well as in the development of spiritual understanding. Allowing for the not infrequent cultural fluctuations during which human attainments have waned while the higher human qualities were conspicuous by their absence, man's tendency as a race under favorable conditions has been to advance.

It is probable that he had an actual Eolithic period when the stone implements he produced had all the crudity of accidental forms. The many adaptive improvements in his flints during the pre-Chellian, Chellian and Acheulian periods led by progressive stages to his pronounced Mousterian productiveness (fig. 19). More striking still was his Aurignacian development with its remarkable outburst of esthetic enthusiasm and artistic creations (fig. 20). If after the Solutrean era his industries began to languish, actually sinking to a low level in the Azilian period, it seems only in preparation for the advent of Neolithic man.



Fig. 21.—Neolithic men of the Nordic race who lived along the shores of the Baltic in the early stage of the New Stone Age. They were the direct forerunners of civilization. They cultivated the ground, domesticated cattle, made pottery and woven textiles, and erected sepulchres and temples of stone (dolmens and megaliths). Painted by Charles R. Knight.

The Cro-Magnon decadence may well have cleared the way for a transition that was to prove portentous in its material and psychic advance. It ushered in a period of practical utilities. It substituted the benefits of applied science for the delusions of expedient sorcery. Neolithic man may have prayed for his crops, but he also tilled the soil and planted seed. He may have had propitiatory ceremonies for his hunting expeditions, but he domesticated animals to guarantee an assured supply of food. The efficiency of reproducing the likeness of game animals in dark caverns did not appeal any longer to his common sense. Unlike his Neolithic successor, the Cro-Magnon was satisfied, according to his lights, by the delusions of his hunting magic and art sorcery. However, Neolithic man had discovered the magic of agriculture and sought to

control nature by the toil of his hands rather than by impractical incantations (fig. 21). As farmer and herdsman he naturally became a landholder. This was a long and provocative step in the direction of modern humanity. It enforced on man the need to defend his claim and assert his right. Quickly enough this new assertiveness led to the more aggressive ages of bronze and iron with their harsher organizations for offense and defense. Ultimately it extended its influences into historic times, creating all of the armed camps known as civilization—ancient, medieval and modern. ✓

The family *Hominidae* has been progressive, by reason of which it differs from all others in the animal kingdom. Here and there about the world it has lagged in its advances. But given its fair opportunity, it has not failed to go forward. The line of this progress may not be deemed wholly satisfactory by the standards of enlightened criticism. Yet in bending the forces of nature more and more to his will and convenience, man has surely progressed. Where he has stood still, perhaps even fallen behind, is in the manifest lack of control over his own nature.

Professor Pawlow, in his epoch-making work on the conditioned reflexes, has portrayed this situation vividly, voicing at the same time the hope of a possible escape from it. While the pall of revolution still hung over him in Soviet Russia, he wrote these inspiring words. "I am deeply and irrevocably convinced that here along this path leads the way to the final triumph of the human mind over its utmost and supreme problem—the knowledge of the mechanism and laws of human nature. Only hence may come a full, true and permanent human happiness. Let the mind rise from victory to victory over surrounding nature; let it conquer for human life and activity, not only all the surface of the earth, but the water and surrounding atmosphere; let it transfer for its purpose prodigious energy from one part of the earth to the other; let it annihilate space for the transference of its thoughts—yet the same human and his mind leading him into dark powers, to wars and revolutions, with their horrors, not calculating the material loss and inexpressible pain, reproduces animal relations. Only science—the exact science about this same human and the most sincere approach to it from the side of Omnipotent Nature will deliver man from his present gloom and will purge him of his contemporary shame in the sphere of human relations."

The brain of prehistoric man seems to shed new light on this path. It seems to give assurance of that deliverance which Pawlow confidently believes awaits mankind.

Since his earliest beginning man has grown in humanity as his brain expanded. Such a conclusion appears irresistible. A comparison of the cerebrum in the stages of human evolution already known to us is sufficient to convince the most skeptical. Placed side by side (fig. 22),

the brain casts of the Javan and the Piltdown man, the Rhodesian and the Neanderthal, the Predmost and the modern demonstrate more effectually than words the extent of this progress. The regions in which expansion has been most pronounced are easily discerned. Increments

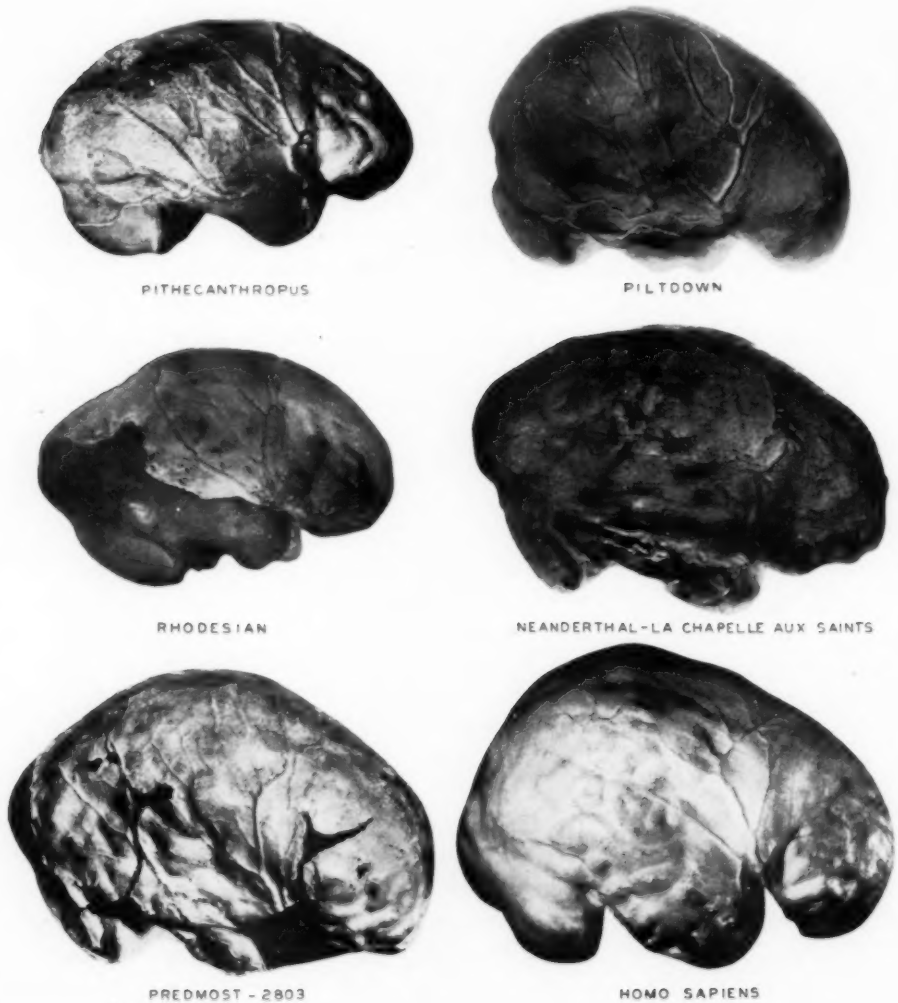


Fig. 22.—Comparison of the endocranial casts of the various races of prehistoric man and *Homo sapiens*.

in the parietal and temporal areas have been steadily maintained throughout this series, but it is in the frontal lobe that decisive advance has occurred. This area, so poorly represented in man's nearest kin, the great anthropoid apes, shows exuberant growth in pithecanthropus. Its features correspond with those of *Homo Sapiens* in nearly all details.

Its only essential inferiority is its relative smallness. Yet even its size is sufficient to justify admission into the human family. Its specializations in the prefrontal area and the development of the inferior frontal convolution denote the acquisition of human speech and reason.

Perhaps it is hazardous to define any single area in the brain as the region supreme in cerebral organization, since the entire neopallium is virtually interdependent throughout all of its special parts. The visual, the auditory and the somesthetic sensory areas contribute so indispensably to life's reactions that one part may not be subordinated to another. This is also true of the motor area, the area regulating skilled movement, and the large intermediate zone that partakes of parietal, occipital and temporal characters. Each of these areas has expanded progressively through the several evolutionary stages of the human brain. Yet it is reasonable to attribute a certain superiority to that neopallial region which is charged with the functional representation of all other cortical territories, which combines the highly particularized functions of all other areas in broader impressions of human existence and which acts as the accumulator of experience, the director of behavior and the instigator of progress. Traced through all their intermediate steps upward, it is exactly these prefrontal and frontal regions that manifest the most conspicuous development. The process of this long continued progressive expansion in the frontal lobe, reaching back to the earliest pleistocene and it may be even into the pliocene, conveys the impression of a responsive plasticity in the human brain. This remarkable antiquity and this salutary plasticity have been largely overlooked. For the most part the human cerebrum is regarded as a finished product. Its evolutionary history does not support this view, but makes it appear far more probable that the brain of modern man represents some intermediate stage in the ultimate development of the master organ of life. In this sense the brain of prehistoric man is of more than antiquarian interest. It has a positive bearing on the future progress of the race.

THE PATHOGENESIS OF CEREBRAL HEMORRHAGE

A CASE OF ANEURYSM OF THE POSTERIOR COMMUNICATING ARTERY *

GEORGE B. HASSIN, M.D.

Professor of Neurology, University of Illinois College of Medicine

CHICAGO

The statistics of Gull,¹ Lebert,² Hofmann,³ Beadles,⁴ Wichern,⁵ Fearnside⁶ and others show that among intracranial aneurysms those of the posterior communicating artery are rare. The case here recorded is remarkable not so much for the clinical as for the pathophysiologic features of cerebral aneurysms, neither of which are sufficiently understood, notwithstanding the large number of cases reported. In general, the extent of the pathologic changes reflects on the clinical picture; yet this may give no indication of the presence of the aneurysm, even if it is large,³ or it may simulate a brain tumor as in the cases of Cushing.⁷ Aneurysm may be suspected when slow leakage occurs, while a sudden rupture is usually accompanied by such severe symptoms that a diagnosis either of meningitis or of intracerebral hemorrhage is made.

For the foregoing reasons intracranial aneurysms are generally of limited clinical value; they are not accessible to treatment even when it is possible to recognize and locate them correctly, as in the cases reported by Symonds.⁸ However, intracranial aneurysms are of great academic interest, for they may throw light on certain pathophysiologic phenomena, such as the genesis and the nature of cerebral hemorrhages. In the case presented here, for instance, a hemorrhage at the base of the brain that resulted from a ruptured aneurysm of a large artery (posterior

* From the pathology laboratories of the Research and Educational Hospitals of the University of Illinois College of Medicine and the State Psychopathic Institute.

1. Gull, W.: Cases of Aneurysm of the Cerebral Vessels, *Guy's Hosp. Rep.* **5**:281, 1859.

2. Lebert, H.: Ueber die Aneurysmen der Hirnarterien, *Berl. klin. Wchnschr.* **3**:208, 229, 249, 281, 336, 345, 386 and 402, 1866.

3. Hofmann, E.: Ueber Aneurysmen der Basilar-arterien u. deren Ruptur als Ursache des plötzlichen Todes, *Wien. klin. Wchnschr.* **7**:823, 848, 867, 1894.

4. Beadles, C. F.: Aneurysms of the Larger Cerebral Arteries, *Brain* **30**:285, 1907.

5. Wichern, H.: Klinische Beiträge z. Kenntniss der Hirnaneurysmen, *Deutsche Ztschr. f. Nervenhe.* **44**:220, 1912.

6. Fearnside, E. G.: Intracranial Aneurysms, *Brain* **39**:224 (Oct.) 1916.

7. Cushing, Harvey: Contributions to the Clinical Study of Intracranial Aneurysms, *Guy's Hosp. Rep.* **72**:159 (April) 1923.

8. Symonds, C. P.: Contributions to the Clinical Study of Intracranial Aneurysms, *Guy's Hosp. Rep.* **72**:139 (April) 1923.

communicating) was associated with multiple intracerebral hemorrhages in the ipsilateral basal ganglia (especially the corpus striatum). While the cause of the basal hemorrhage was clear, that of the intracerebral hemorrhages was not. An attempt has been made to follow up the genesis of the latter on the basis of existing theories and hypotheses as to the origin of cerebral hemorrhages in general.

REPORT OF CASE

Clinical History.—A negress, aged 39, was admitted to the neurologic service of Cook County Hospital, Feb. 23, 1925, where she died ten hours later. For two weeks prior to admission to the hospital, the patient had been complaining of headache in the cervico-occipital region. At times this was so severe that she was compelled to go to bed. Rest and acetylsalicylic acid would give temporary relief, but if she attempted to be up and around, the headache would become unbearable. Relatives stated that she often had dizzy and fainting spells, but they did not know whether these were accompanied by vomiting or not. A reliable history could not be obtained as to the patient's previous health, venereal or other infectious diseases, or of her family. On the night preceding admission, the patient, while in bed, apparently fell asleep, and as she could not be aroused she was brought to the Cook County Hospital.

Clinical Examination.—When examined by my intern, Dr. Wakefield, the woman was found to be well nourished; she was in deep coma. Signs of injury to the skull, such as bleeding from the ears, nose or mouth, were absent. The eyelids were drooping; the pupils were irregular and unequal; the left was larger than the right and did not react to light, while the right pupil reacted well to light. The face apparently was symmetrical; the neck was not rigid, and Kernig and Brudzinsky signs were absent. The breathing was stertorous, 40 respirations a minute, with numerous râles which obscured the cardiac sounds. The blood pressure was 170 systolic and 90 diastolic. The extremities were flaccid; the tendon reflexes were absent, and there was no response to painful stimulations. Urinary retention required catheterization, which revealed albumin (++) and casts (++) but no sugar.

The spinal puncture showed marked xanthochromia (in three consecutive tubes), a positive benzidine and a negative Wassermann reaction; the blood Wassermann reaction was +++; the pressure of the spinal fluid was 0. Chemical examination of the blood showed: nonprotein nitrogen, 35 (instead of 26) and creatinine, 1.87 (instead of 1.35). The rectal temperature was 100.6 F. and the pulse rate 116.

Necropsy Examination.—Dr. Harry Singer reported a saccular aneurysm, 6 mm. in diameter, of the anterior (?) communicating artery (this evidently was a mistake, as the artery on subsequent examination was found intact) of the circle of Willis; recent aneurysmal rupture with an extensive subdural hemorrhage; marked edema of the brain; aneurysmal erosion of the posterior clinoid processes; slight internal hydrocephalus; hemorrhagic effusion into the posterior lobe of the hypophysis; free blood everywhere over the surface of the cerebral dura, especially at the base of the brain; a considerable amount of dark clotted blood about the optic chiasm. The spinal fluid and the leptomeninges were uniformly blood stained. The heart and kidneys showed no abnormalities.

The brain, hardened in solution of formaldehyde, was delivered to my laboratory six months after the necropsy. The aneurysmal dilatation was at the place

of origin of the left posterior communicating artery from the internal carotid and near the middle cerebral artery. It was hard to tell, on cursory examination, which of these three blood vessels was implicated, on account of the proximity of the aneurysm to the internal carotid and the middle cerebral artery (fig. 1).

Sections (frontal) of the brain revealed, in addition to the foregoing observations, a large number of hemorrhagic foci located mainly in the left lenticular nucleus; few were present in the optic thalamus and none in the globus pallidus.

Microscopic Examination.—The hemorrhages were round, oval and irregular, and varied greatly in size (fig. 2), from small capillaries to large ones that could be discerned with the naked eye. As a rule, they enveloped, mufflike, the blood vessels (arterioles, veins and occasionally capillaries) or were in the form of small blood clots adherent to their sides. In some instances, large hemorrhages

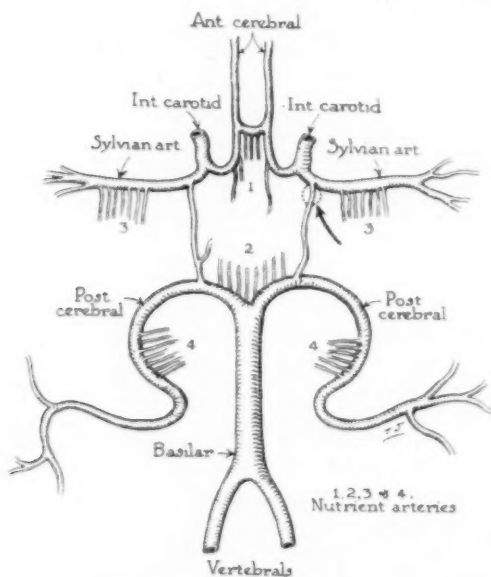


Fig. 1.—The circle of Willis. The arrow indicates the location of the aneurysm. (The diagram is taken from Charcot.)

were present, around minute blood vessels, even capillaries, and in others small hemorrhages were seen around larger vessels. In some sections, no blood vessels could be discerned within the hemorrhagic focus (fig. 2). This probably was due to the fact that either the sections did not include the blood vessels or the extravasated blood invaded some areas by imbibition; that is to say, by invasion from a larger focus. Sometimes two or more blood vessels were enclosed within one focus, their configuration being retained. Occasionally, a blood vessel, cut longitudinally, exhibited globular dilatations somewhat resembling aneurysms (fig. 3). The majority of the arteries and especially of the veins were markedly hyperemic; the capillaries were exceedingly numerous, and likewise distended and hyperemic.

In many instances the hemorrhages were within the confines of the adventitial layer; they were often outside the latter, but as a rule were enveloped by a thin strand of connective tissue emanating from the adventitia, and formed what is



Fig. 2.—Hemorrhagic foci in the left lenticular nucleus. Uran-Gallein stain; $\times 40$.



Fig. 3.—Globular or ampullar dilatations of a venule. The larger dilatation shows a rent with blood extravasation. Uran-Gallein stain; $\times 190$.



Fig. 4.—Extramural hematomas with a torn adventitia. X is evidently a rupture with a secondary blood extravasation; the string of connective tissue enveloping the hemorrhage emanates from the vein to the right. Alzheimer-Mann stain; $\times 140$.

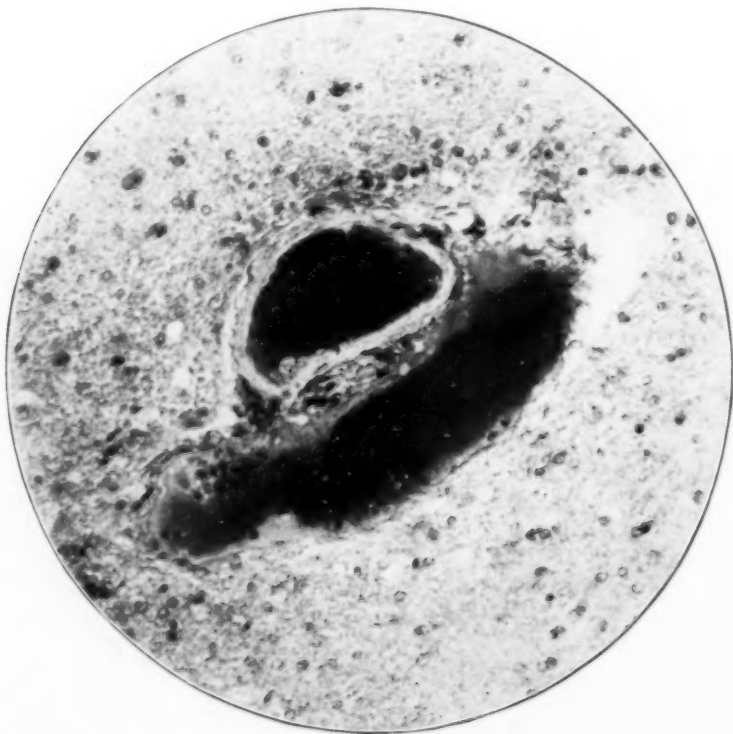


Fig. 5.—An artery and vein; their walls appear homogeneous; the vein, to the right, is distended. Van Gieson stain; $\times 250$.

known as extramural hematoma (fig. 4). In some areas the hemorrhagic focus was covered by a network of thin, connective tissue fibers, while in other cases the hemorrhages were in the form of small irregular foci loosely attached to the blood vessel walls or enveloping the latter along the so-called spaces of His.

Dense as the foci of the hemorrhages were, they were always separated from one another by healthy brain tissue from which they were sharply demarcated; in other words, reactive phenomena around the hemorrhages on the part of the parenchyma, glia or connective tissue were absent.

The blood vessels themselves which, as noted, were numerous and hyperemic, on superficial examination showed no changes. The capillaries were particularly

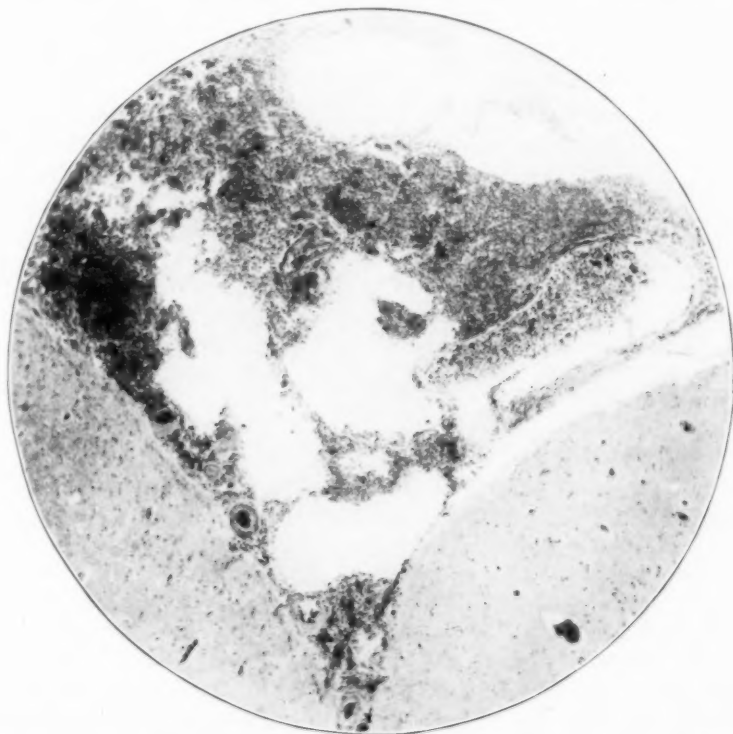


Fig. 6.—Hemorrhage over the convexity of the brain. Hematoxylin-eosin stain; $\times 40$.

normal, whether surrounded by blood or not. The arteries, both small and larger, almost always contained blood or a homogeneous mass adjacent to the inner vessel wall, and exhibited the three layers, including an inner elastic membrane. This was always normal. The intima cells were swollen and pale and were almost devoid of chromatin granules, but well stained and visible processes emanated from their poles. Nowhere did the intima appear thickened or hyperplastic, but at the base of the brain, in the basilar artery, it was markedly thickened and protruded into the lumen. The muscle tunic of the intracerebral arterioles showed great poverty in nuclei (fig. 5); it stained badly, appearing brownish and usually homogeneous in van Gieson specimens. The adventitia almost always was thickened and hyperplastic; often it was torn, or broken up

by hemorrhages into numerous shreds that were hanging loosely from the vessel walls (fig. 4). Like the media it showed great poverty of nuclei. In general, the striatal arteries appeared as rather badly stained homogeneous structures, their walls poor in cellular elements, usually distended with blood and for the most part enveloped by hemorrhages.

The veins were apparently much more involved. They were markedly distended (fig. 5), their walls irregular and often thinned; the intima cells were round, pale or colorless; the muscle layer was hardly discernible, but the adventitia, as a rule, was thickened and often poorly demarcated from the surrounding hemorrhages. In some rare instances, a tearing that impressed one as a rupture of the wall could be discerned (fig. 3). Though especially in evidence in areas affected by the hemorrhages, the foregoing vascular changes were also somewhat in evidence in the rest of the brain; for instance in the pons, in which occasionally a capillary hemorrhage could be found.

The cortex was practically free from vascular changes, but the subarachnoid space, on the base as well as over the surface (fig. 6), was packed with blood, numerous macrophages filled with blood pigment and proliferated mesothelial cells.

The ganglion cells in the cortex showed no changes. In the basal ganglia, especially the putamen, they often exhibited changes. These, however, were rather mild: chromatolysis, pale nucleus and occasionally a slight neuronophagia. Neither the glia nor the nerve fibers showed any changes; nowhere were the latter torn by the hemorrhages, nor did the former exhibit progressive or reactive phenomena. Only in single instances could so-called cytoplasmic glia be seen outside the adventitial walls of the blood vessels.

Summary of Pathologic Observations.—Pathologic changes noted were: ruptured aneurysm of the left posterior communicating artery at the point where it branches off from the internal carotid; hemorrhages with reactive phenomena in the subarachnoid spaces of the base and convexity of the brain; multiple hemorrhages in the basal ganglia, especially the putamen, on the same side; vascular changes involving the intima and media of the smaller blood vessels; numerous extramural hemorrhages (false aneurysms) and occasional globular or ampullar dilatations with apparent rupture of the vessel walls; mild ganglionic nerve changes in the lenticular nucleus and absence of periarteritis and of reactive glia changes.

Method of Staining Sections in This Case.—The Uran-Gallein stain employed extensively in this study was prepared as follows: (1) Dissolve uranium acetate, 0.1–0.5 Gm.; sodium citrate, 2.0; sodium carbonate, 0.2; in aqua destillata, 50 cc. This solution will keep for three weeks or a month if placed in tightly stoppered bottles. It may be kept indefinitely if sterilized and placed in the dark. Light causes it to turn brown but in no way renders it unfit for use. (2) Gallein (Merck), 0.1 Gm., is added to 10 cc. of the uranium solution. The mixture is boiled for two minutes and the solution cooled. The resultant purplish red solution will keep for three or four weeks in the dark and if desired may be filtered before use.

Staining Method: 1. The preparation should be fixed in solution of formaldehyde or, better, Müller formaldehyde solution. For rapid work frozen sections should be used; paraffin or celloidin sections may be used also. 2. Sections are immersed in the staining solution for from five to ten minutes and washed in tap or distilled water for one or two minutes; for finer differentiation they should be washed for from five to ten minutes; prolonged washing slowly decolorizes

both the protoplasm and the nuclei. 3. The sections may then be mounted in glycerin and kept for several days; or after being washed in water they may be dehydrated in absolute alcohol for from three to four minutes, then cleared in oil of bergamot and mounted in damar balsam.

The nuclei are stained purplish red; the protoplasm lavender; red cells, deep brownish red; elastic fibers, deep violet blue; connective tissue, light brownish red. Muscle tissue varies from a deep brownish red to purplish red (Proescher and Krueger: A New Rapid Elastic Stain Producing Simultaneous Staining of Nuclei and Protoplasm, *J. Lab. & Clin. Med.* **10**:862 [July] 1925).

COMMENT

The changes outlined occurred in a comparatively young woman with high blood pressure, a history of severe headache and a positive Wassermann reaction. The clinical symptoms were coma, paralysis of the left third nerve and xanthochromia. The coma set in two weeks after the onset of the headache and, like it, was due to an aneurysm. This, however, must have been present for more than two weeks; that is to say, it had existed for some time without causing the patient any discomfort before its rupture. Another noteworthy feature was the absence of blood in the spinal fluid. Instead, xanthochromia, in this case of hemogenous origin, was present.

Of special interest was the association of the hemorrhage from a ruptured posterior communicating artery with multiple hemorrhages from another branch of the internal carotid—the middle cerebral artery. Of this only the so-called nutrient, subcortical branches to the basal ganglia were involved, the blood over the cortex most likely having resulted from the basal hemorrhage. Absence of reactive phenomena in the large ganglia and their presence in the subarachnoid space suggest that the basal meningeal hemorrhage preceded the intracerebral. The latter was evidently recent, secondary to the former, and most probably occurred in the agonal stage of the disease. Though not unusual in cases in which aneurysmal ruptures are absent, agonal hemorrhages, however, are never so extensive and intensive as they were in this case. Some additional factors, therefore, must have been responsible for the extensive agonal hemorrhages. Of such factors, two deserve particular attention: one anatomic, in the form of vascular changes; the other, physiologic, in the form of increased blood pressure confined to the intracerebral system (middle cerebral artery) of the internal carotid.

The anatomic factor, evidenced on the base of the brain as an aneurysm of the posterior communicating artery, was much less marked in the basal ganglia where it showed as degeneration of the inner two layers of the blood vessel walls. Under certain conditions, such vascular degenerative changes may result in the formation of aneurysms and may therefore be termed pre-aneurysmal. Aneurysm formation, according to

Charcot and Bouchard,⁹ is the essential factor in the causation of cerebral hemorrhages. In 1868, they promulgated the widely accepted theory that the majority of cerebral hemorrhages are due to rupture of miliary aneurysms. The number of these is usually great and their size small, from 0.1 to 1 mm., and they may exist in the brain for a long time without discomfort to the patient previous to rupture. Charcot and Bouchard ascribe the formation of the miliary aneurysms to a diffuse inflammation of the adventitia, a "periarteritis" of the entire system of the small intracerebral blood vessels. By spreading inward, the periarteritis may involve, secondarily, the muscle layer and the intima. If the adventitia is not thickened and does not become fibrous, the blood vessel wall becomes dilated, forming ampullae at the points where the atrophy of the middle or muscle layer is especially marked, giving rise to aneurysm formation. The "sclerous" periarteritis thus "prepares and accompanies" the intracerebral miliary aneurysms. These were found in 100 per cent of cases of cerebral hemorrhage, while arteriosclerotic changes ("atheromatosis" or "sclerous endarteritis") were absent in 22 per cent of the cases. Charcot and Bouchard, therefore, did not consider arteriosclerosis the essential cause of cerebral hemorrhages.

In my case, the intracranial hemorrhages took place without aneurysm formation, for only exceptionally were ampullar dilatations of blood vessels (fig. 3) found. In contrast, so-called false aneurysms in the form of intramural and extramural hematomas were of frequent occurrence. I could not find any signs of periarteritis, which, according to Charcot and Bouchard, is always present in brains harboring aneurysms, with or without hemorrhages, whether these are recent or old.

Assuming that my method of study in this case, sectioning of the entire block, was inadequate for demonstrating miliary aneurysms, so numerous in the basal ganglia according to Charcot and Bouchard, still the absence of reactive phenomena would speak against the miliary aneurysm causation of the hemorrhages. As noted, miliary aneurysms are small (according to Ellis,¹⁰ their size is from 0.03 to 0.25 mm.), and rupture would give rise to equally minute blood extravasations; these would also be slow and consequently would allow sufficient time for reactive phenomena to set in. The absence of reactive phenomena around an immense number of small as well as large hemorrhages denotes that the hemorrhages occurred simultaneously from numerous blood vessels and that they did not have time to coalesce to form larger foci because of death. Fusion of small hemorrhages as a possible factor in the causation of large, fatal, cerebral hemorrhages has been advocated by older authors

9. Charcot, J. M., and Bouchard, C.: *Nouvelles recherches sur la pathogenie de l'hémorragie cérébrale*, Arch. d. phys. norm. et path. **1**:110, 643 and 725, 1868.

10. Ellis, A. G.: *The Pathogenesis of Spontaneous Cerebral Hemorrhage*, Proc. Path. Soc., Philadelphia **30**:197, 1909.

(Rokitansky,¹¹ for instance), but as Pick¹² pointed out, there is no proof that miliary aneurysms, even when ruptured in large numbers, cause fatal hemorrhage. He demonstrated that such may occur from rupture of larger, "supermiliary" aneurysms which are much fewer than the miliary form and in which ruptures easily can be demonstrated. With Eppinger¹³ and Ellis,¹⁰ he maintains that miliary aneurysms are not real but false formations, and that their rôle in the causation of cerebral hemorrhages is exaggerated. Pick adds that even the supermiliary aneurysms are not essential in the genesis of cerebral hemorrhages, and in contrast to Charcot and Bouchard holds that the essential cause of cerebral hemorrhages is not aneurysms but arteriosclerosis.

Some older investigators considered the parenchymal, not the vascular, changes responsible for the occurrence of hemorrhages in the brain. Thus, Rochoux¹⁴ spoke of "hemorrhagic softening," an area around the hemorrhagic focus 3 or 4 mm. thick: "In this zone the cerebral substance is softened and is distinguished by its canary yellow color from the white colored surrounding tissue." Charcot adds: "These lesions have been considered by some authors as the result of softening precedent to the hemorrhage, and Todd tried to rejuvenate this view without bringing any very convincing reasons in support of his opinion."

Durand-Fardel¹⁵ also placed the cause of hemorrhages outside the blood vessels. He thinks that a hemorrhage in the brain is due to a slow "disorganizing" process which in the long run alters the "cohesion" of the cerebral tissues. These may suddenly rupture "under efforts of abnormal blood impulse."

Even some of the present authors are not satisfied with the vascular theory of cerebral hemorrhages. Meylahn,¹⁶ for instance, goes so far as to deny the rupture or any other vascular changes as the usual cause, but sees the latter in diapedesis and constitutional weakness of the cerebrospinal system, especially of the nerves of the blood vessels.

It is needless to argue that none of the foregoing theories are borne out by the observations in this case. Areas of hemorrhagic softening as

11. Rokitansky, Carl.: *Lehrb. d. pathologischen Anatomie*, vol. 2, Wien., 1856.

12. Pick, L.: Ueber die sogenannten miliären Aneurysmen der Hirngefässe, *Berl. klin. Wchnschr.* **47**:325 and 382 (Feb.) 1910.

13. Eppinger, Hans: Sogenannte Hirnarterienaneurysmen, *Arch. f. klin. Chir.* **35**:546, 1887; die miliären Hirnarterienaneurysmen (Charcot-Bouchard), *Virchows Arch. f. path. Anat.* **111**:405, 1888.

14. Rochoux: *Recherches sur l'apoplexie*, Paris, 1814, ed. 2, 1833, quoted by Charcot: *Clinical Lectures on Senile and Chronic Diseases*, New Sydenham Society, London, 1881.

15. Durand-Fardel: *Traité pratique des maladies des vieillards*, Paris, 1873.

16. Meylahn, K.: Ueber spontane Meningealblutungen, *Deutsche Ztschr. f. Nervenhe.* **78**:78, 1923.

described by Rochoux were nowhere found. Their occasional presence in large hemorrhages, as Charcot and Jackson¹⁷ justly pointed out, is, secondary to hemorrhage, the result of infiltration by the serum of the effused blood, and is by no means a lesion preparatory to the hemorrhage. As to the diapedesis theory, it is hardly conceivable that the extensive tearing of the adventitia in the present case could have been caused by such a mild process.

It is almost universally agreed that before a cerebral hemorrhage occurs a blood vessel must be injured, with or without aneurysm formation, though injured blood vessels with subsequent hemorrhages may be only a partial manifestation of a general intoxication, infection (septicemia) or some constitutional disorder (severe anemia, purpura, scurvy). The type of hemorrhages, confined as in this case to some portions of the brain, is primarily due to a diseased condition of the blood vessels, principally their intima and media. Rosenblath¹⁸ and Westphal and Bär,¹⁹ designate the vascular changes as angioneerosis, a condition in which all three layers, including the adventitia, are injured. These authors assert that angioneerosis aided by secondary conditions, such as increased blood pressure and vasomotor or angiospastic states, may lead to a cerebral hemorrhage. In other words, in every case of hemorrhage these two factors must be present.

While in my case the anatomic factor was demonstrable, the physiologic factor—increased blood pressure in the vascular system of the basal ganglia—requires some explanation. The patient did have a high blood pressure (170 systolic and 80 diastolic) which, however, could be borne by the blood vessels until the aneurysm at the base of the brain ruptured. The rupture was necessarily followed by a fall of the blood pressure in the system of the internal carotid, especially in the middle cerebral artery. The nutrient branches of the latter have an almost perpendicular course and the fall of blood pressure in them must have resulted in its corresponding rise in the veins of the same system. As figure 1 shows, the aneurysm was situated just at the point at which the middle cerebral artery branches off from the internal carotid, and the effects of its rupture must have affected the condition of the blood supply and the pressure in the internal carotid. The increase in the venous pressure of the middle cerebral system produced in its turn an extensive hyperemia of the capillaries and rupture of the venules. In other words, the multiple intracerebral hemorrhages in this case were

17. Jackson, Hughlings: Cerebral Hemorrhage and Apoplexy, Reynold's System of Medicine, American edition 1:902, 1879.

18. Rosenblath: Ueber Entstehung der Hirnblutung bei dem Schlaganfall, Deutsche Ztschr. f. Nervenhe. 61:10, 1918.

19. Westphal, K., and Bär, R.: Ueber die Entstehung des Schlaganfalles, Deutsches Arch. f. klin. Med. 151:1, 1926.

secondary to arterial basilar hemorrhage; they came from the veins, which were uniformly distended, their walls thinned and usually obscured by blood. As noted, they were agonal and therefore unaccompanied by reactive phenomena and were confined to the territory supplied by the most vulnerable branch of the internal carotid—the middle cerebral artery.

The explanation suggested here for the origin of the intracerebral hemorrhages—the rise of the venous blood pressure caused by the fall in the arterial system—is somewhat in accord with that of Westphal.²⁰ He believes that a hemorrhage in the brain is prone to be hastened by a number of factors. The primary or principal phenomenon is hypertonia with an acute or sudden anemia of circumscribed areas of the brain. This is caused by "angiospastic and arteriosclerotic functional disturbances" in the cerebral arteries which, followed by reopening of the arteries, lead to a "rush of blood" (*Durchblutung*). In short, "spastic ischemia" is the dominant factor in the genesis of "apoplectic hemorrhages," while arteriosclerosis or miliary aneurysms are, in his opinion, not sufficient to cause them.

It is most probable that aneurysms—miliary, submiliary or supermiliary—merely denote an advanced vascular lesion. Like their underlying cause, degeneration of the vessel walls, they may be present for a long time without causing clinical symptoms or signs. Their frequent occurrence in extensive, massive, cerebral hemorrhages, in which the brain tissues are crushed, naturally suggests their possible dominance in the etiology of cerebral hemorrhages. In extensive cerebral hemorrhages we deal with terminal conditions. Therefore, cases of this kind are not altogether suitable for such studies. In contrast, cases similar to the one here recorded may serve such a purpose much better, notwithstanding the fact that the anatomic changes, being less spectacular in this case, are somewhat more difficult to understand and interpret. The phenomena here are in their initial, embryonic stage, the destruction of the contiguous tissues being eliminated.

Cases of intracranial aneurysms should therefore be utilized not so much for statistical or ornamental purposes (as museum specimens) as for detailed studies of microscopic changes which, as pointed out, may help in settling the important question as to the genesis of aneurysms in general and cerebral hemorrhages in particular.

CONCLUSIONS

1. An aneurysm of a large artery at the base of the brain was associated with vascular changes in the basal ganglia.

20. Westphal, K.: *Deutsches Arch. f. klin. Med.* **151**:31, 1926.

2. A hemorrhage from the ruptured aneurysm was followed by numerous blood extravasations in the ipsilateral basal ganglia.

3. The cause of the hemorrhages in both instances was increased intracranial blood pressure and vascular changes.

4. As the result of the latter the aneurysm ruptured first, causing a local fall in the arterial blood pressure; this in its turn caused a rise in the blood pressure in the corresponding veins and their rupture.

5. The hemorrhages from the veins were thus secondary and agonal; therefore, they were not accompanied by reactive phenomena.

6. Miliary aneurysms are not essential in the genesis of cerebral hemorrhages.

THE FORM OF THE ANTERIOR HORN CELLS OF VERTEBRATES *

ARTHUR WEIL, M.D.

NEW YORK

In a recently published paper, which formed the conclusion of work begun in this laboratory by W. M. Kraus in 1922, we¹ were able to show the elongation of the human anterior horn cell in the course of ontogenetic development. These cells, which up to the fourth embryonic month have the shape of a globe, are finally elongated in adult man, and the caudocranial diameter is three times as large as the transverse diameter. We tried to explain this phenomenon by neurobiotactic influences of higher centers on the motor cells of the spinal cord and as an expression of gradually increasing intersegmental integration.

One might object to this theory and try to explain the elongated form by physical influences of growth, by the extension of the spine and by the action of gravity on erect man. In order to test the validity of such objections, examinations of spinal cords of different vertebrates were undertaken with the result that even in a horizontal position of the spinal cord this phenomenon of elongation occurred. At the same time, the investigations revealed the fact that the form of anterior horn cells of vertebrates shows in the phylogenetic ascendant the same phenomenon that was demonstrated in the ontogenesis of the human embryo.

The technic was the same as that described in the last publication. The wax models were made from series of transverse sections; therefore, the upper and lower tip of the cell could not be reconstructed. The models of the human embryo and amphibian cell are ideal reconstructions from two successive transverse sections. The photographs of the models are taken on the same scale, and they may be used, therefore, for comparison of the form of the different cells. The enlargement of the original wax models was 1:700.

The nomenclature follows that of the first publication. Diameter (1) is the largest diameter of anterior horn cells in transverse sections; (2) is the diameter perpendicular to (1); (3) is the longest diameter in longi-

* From the Neuropathology Laboratory of Montefiore Hospital.

* Models demonstrated and paper read by title at the Fifty-Second Annual Meeting of the American Neurological Association, Atlantic City, N. J., June, 1926.

1. Kraus, W. M., and Weil, Arthur: Human Adult and Embryo Anterior Horn Cells, *Arch. Neurol. & Psychat.* **15**:686 (June) 1926.

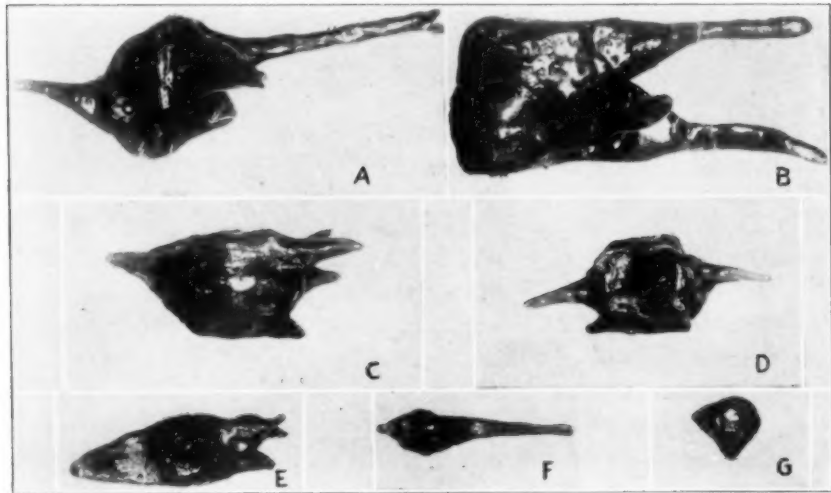


Fig. 1.—Wax models of anterior horn cells of the dorsal segments of vertebrates. Enlargement, 1:700. *A*, human adult; *B*, carp; *C*, cat; *D*, pigeon; *E*, turtle; *F*, newt; *G*, human embryo—4 months.

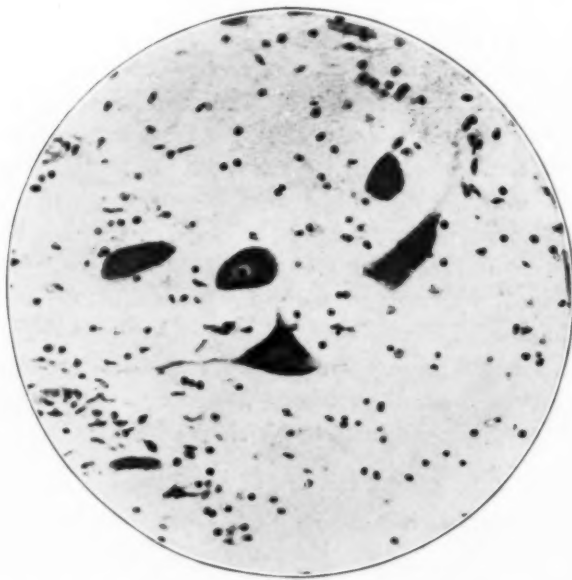


Fig. 2.—Transverse section through dorsal segment of dog. Toluidin blue. Zeiss ap. 8 mm.; comp. ocul. $\times 10$.

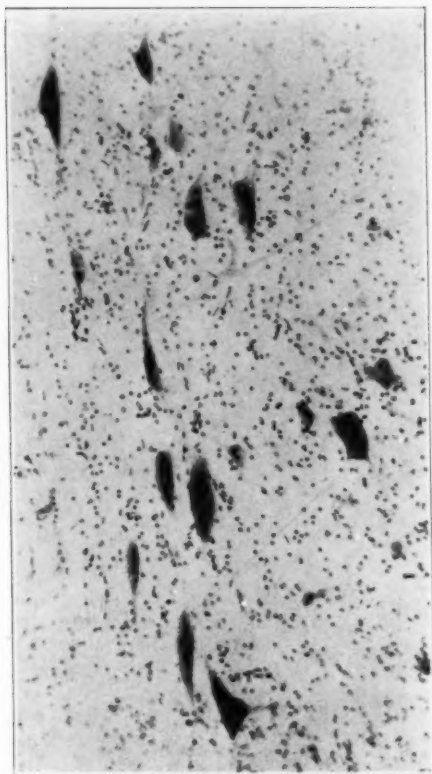


Fig. 3.—Longitudinal section through dorsal segment of dog. Toluidin blue stain. Zeiss 8 mm. apochrom.; comp. ocul. $\times 10$.



Fig. 4.—Longitudinal section through dorsal anterior horn cell of dog. Zeiss ap. 4 mm.; comp. ocul. $\times 15$.

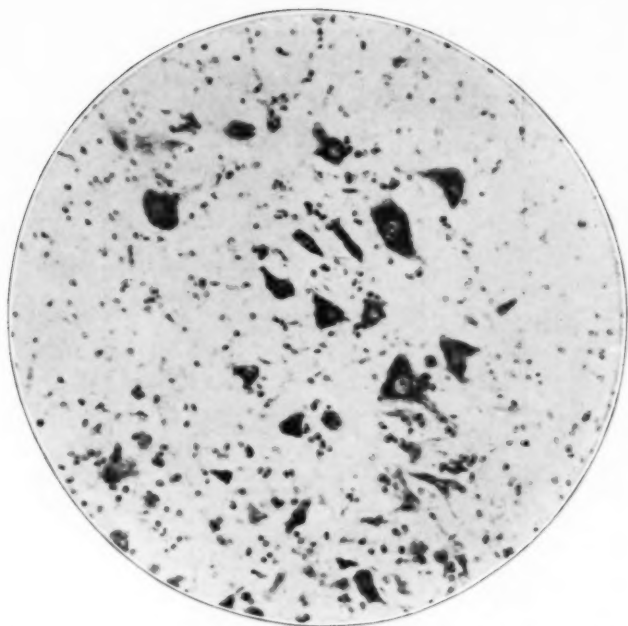


Fig. 5.—Transverse section through dorsal segment of spinal cord of pigeon. Toluidin blue. Zeiss 8 mm. ap.; comp. ocul. $\times 10$.



Fig. 6.—Longitudinal section of same segment as figure 5. Zeiss 8 mm. ap.; comp. ocul. $\times 15$.

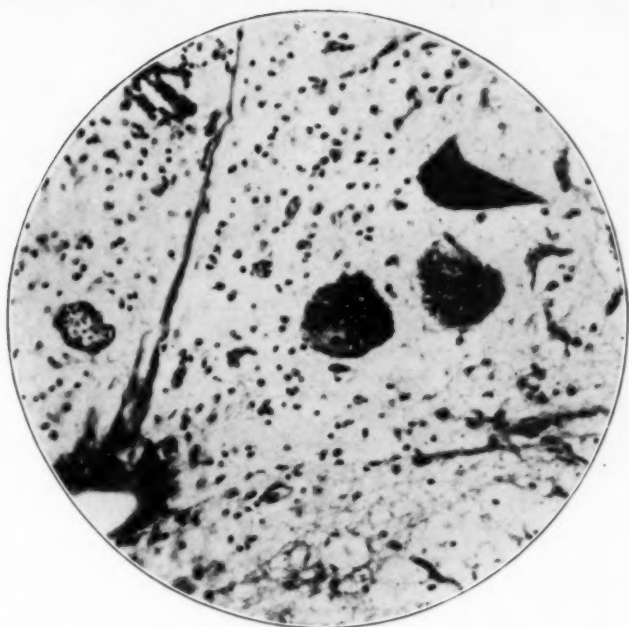


Fig. 7.—Transverse section through dorsal segment of spinal cord of carp.
Zeiss 8 mm. ap.; comp. ocul. $\times 10$.



Fig. 8.—Longitudinal section through dorsal segment of spinal cord of carp.
Zeiss 8 mm. ap.; comp. ocul. $\times 10$.

TABLE 1.—Anterior Horn Cells in Cervical Segments of the Spinal Cord of Vertebrates*

Animal	Measures in Microns			Relations of the Three Diameters	Relation of Transverse to Longitudinal Diameter
	2	1	3		
Mammalia					
Man (Homonidae).....	22	42	81	1 : 1.9 : 3.7	1 : 1.9
Guinea-pig (Rodentia).....	25	40	65	1 : 1.6 : 2.6	1 : 1.6
Dog (Carnivora).....	34	55	77	1 : 1.6 : 2.4	1 : 1.4
Cat (Carnivora).....	33	50	72	1 : 1.5 : 2.2	1 : 1.4
Aves					
Pigeon (Columbae).....	26	37	56	1 : 1.4 : 2.2	1 : 1.5
Pisces					
Carp (Teleostei).....	50	74	101	1 : 1.5 : 2.0	1 : 1.4
Reptilia					
Turtle (Chelonia).....	22	35	50	1 : 1.6 : 2.3	1 : 1.4
Amphibia					
Newt (Urodela).....	13	23	25	1 : 1.7 : 1.9	1 : 1.1
Human embryo, 4 months..	19	22	23	1 : 1.2 : 1.2	1 : 1.0

* In this and table 2, 1 indicates the longest diameter of a cell in transverse sections; 2 is the diameter perpendicular to 1; 3 is the longest diameter of a cell in longitudinal sections.

TABLE 2.—Anterior Horn Cells in Dorsal Segments of the Spinal Cord of Vertebrates

Animal	Measures in Microns			Relations of the Three Diameters	Relation of Transverse to Longitudinal Diameter
	2	1	3		
Mammalia					
Man (Homonidae).....	16	30	88	1 : 1.9 : 5.5	1 : 2.9
Guinea-pig (Rodentia).....	17	25	66	1 : 1.6 : 3.8	1 : 2.4
Dog (Carnivora).....	27	44	85	1 : 1.6 : 3.1	1 : 1.9
Cat (Carnivora).....	29	43	82	1 : 1.5 : 2.9	1 : 1.9
Aves					
Pigeon (Columbae).....	14	24	49	1 : 1.7 : 3.2	1 : 2.0
Pisces					
Carp (Teleostei).....	43	68	106	1 : 1.6 : 2.5	1 : 1.6
Reptilia					
Turtle (Chelonia).....	22	38	53	1 : 1.7 : 2.4	1 : 1.4
Amphibia					
Newt (Urodela).....	12	20	23	1 : 1.7 : 1.9	1 : 1.2
Human embryo, 4 months..	15	22	28	1 : 1.5 : 1.9	1 : 1.3

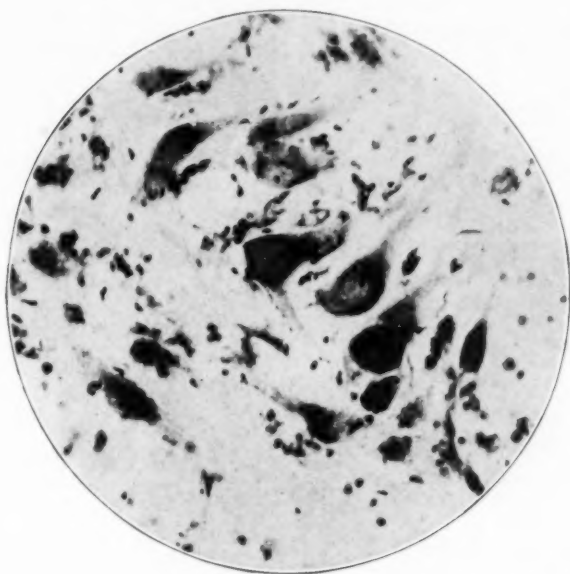


Fig. 9.—Transverse section through dorsal segment of spinal cord of turtle. Zeiss 8 mm. ap.; comp. ocul. $\times 10$.

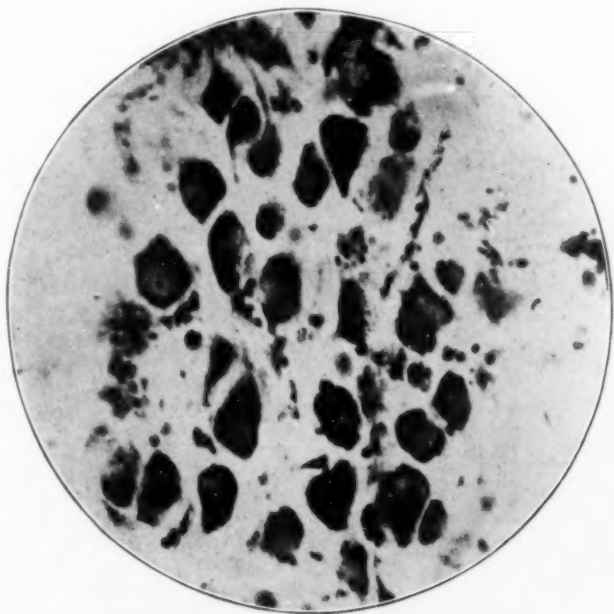


Fig. 10.—Longitudinal section through dorsal segment of spinal cord of turtle. Zeiss 8 mm. ap.; comp. ocul. $\times 10$.

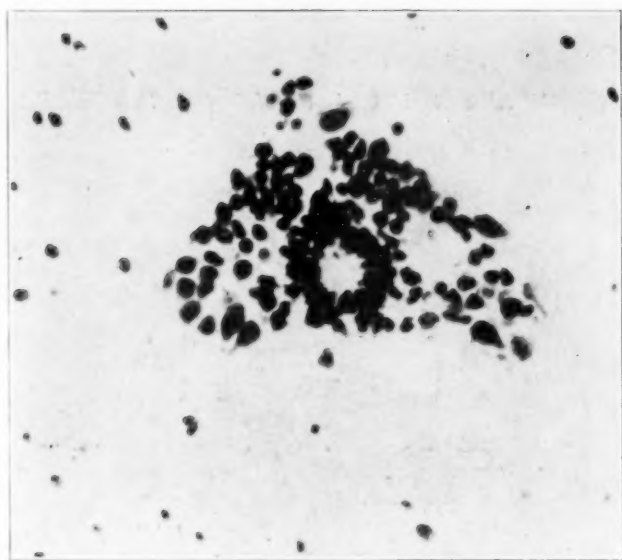


Fig. 11.—Transverse section through dorsal segment of spinal cord of newt. Toluidin blue. Zeiss 16 mm. ap.; comp. ocul. $\times 7$.

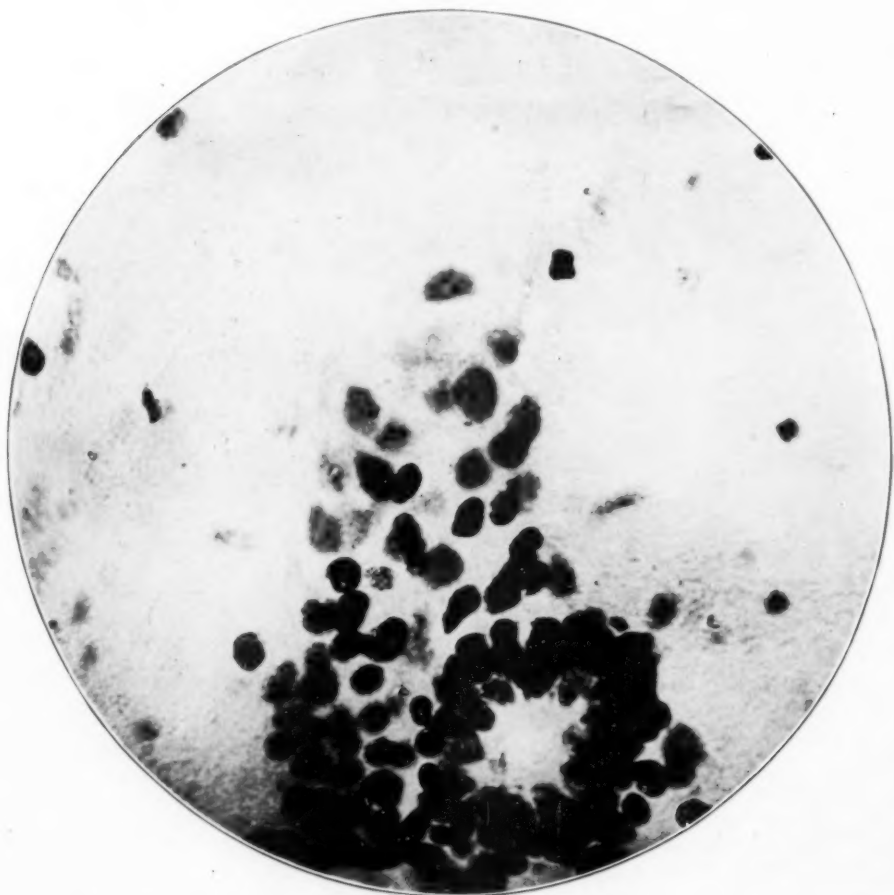


Fig. 12.—Same section as shown in figure 11. Zeiss 4 mm. ap.; comp. ocul. $\times 10$.

tudinal sections and corresponds approximately to the longest cephalo-caudal diameter of the cells. The term "anterior horn cells" should be applied only to reptiles, birds and mammals; in fish and amphibia the term should be "lateral horn cells." In the last two classes, the motor

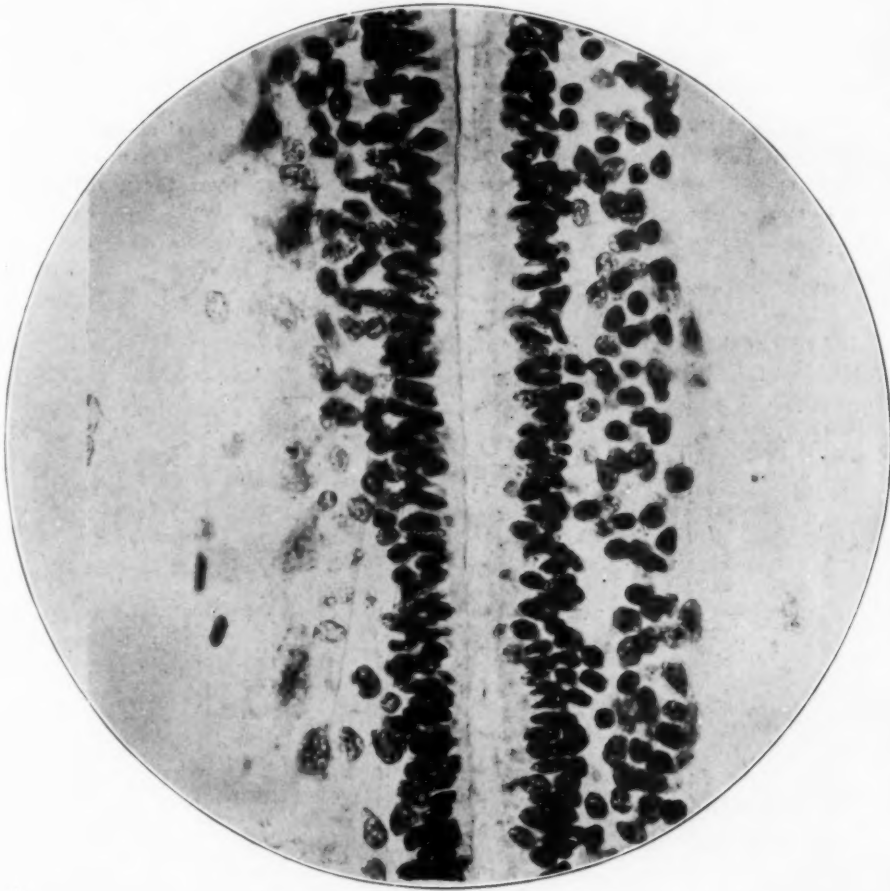


Fig. 13.—Longitudinal section through dorsal segment of spinal cord of newt. Zeiss 8 mm. ap.; comp. ocul. $\times 10$.

ganglion cells may be easily recognized, in amphibia by the pale staining of the nucleus and the more pronounced differentiation of the cytoplasm.

Study of these measurements, which are condensed in the two accompanying tables, shows the following: Throughout all the vertebrate classes there is the same difference between cervical and dorsal cells,

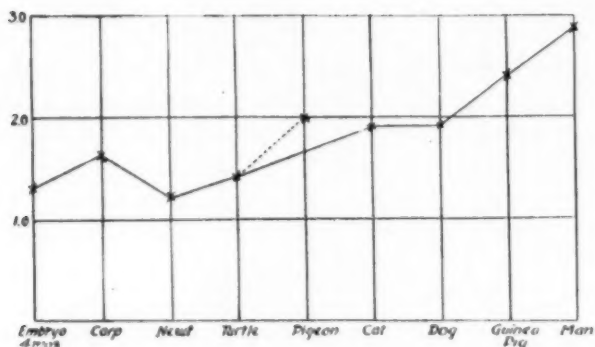


Fig. 14.—Diagram to show the relationship in the longitudinal elongation of the vertebrate dorsal anterior horn cells. Numbers left of the ordinate indicate how many times the longitudinal diameter is larger than the transverse diameter.

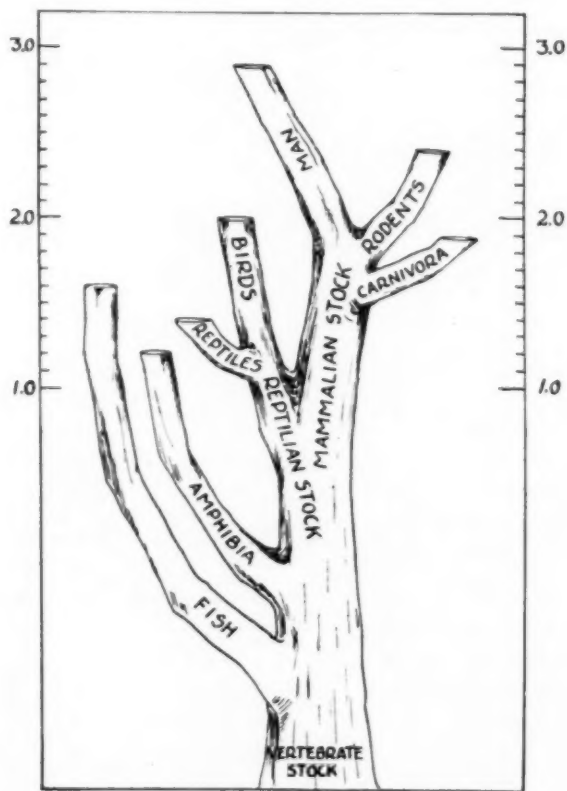


Fig. 15.—Diagram to show the evolution of vertebrates and the elongation of anterior horn cells at the different stages of vertebrate evolution. The numbers to the right and left indicate how many times the longitudinal diameter surpasses the transverse diameter. (Example: in human dorsal anterior horn cells the longitudinal diameter measures 88 microns, the transverse diameter, 30 microns. Relation $88:30 = 2.9$). The branch of each class is drawn up to the level of the corresponding relation.

which was already described in man, i. e., the cervical cells are more voluminous, but the dorsal cells are more elongated as expressed by the relation of the transverse diameter to the longitudinal diameter. Furthermore, in the dorsal cells, one finds, in amphibia, that the transverse and longitudinal diameters show only a slight difference, their relation being 1:1.2. Therefore, these cells resemble in their globular form the human embryo cells of the fourth month and even correspond to them in their actual measurements. In reptiles a slight elongation sets in, which increases the caudocranial diameter to one and one-half times the largest transverse diameter. In birds and carnivora the elongation is greater, the longitudinal diameter being twice as long as the transverse. In rodentia the elongated form is still more pronounced, and in man it reaches its maximum. The representative of fishes does not fit exactly into the scheme of evolution; according to the form of its cells it should be placed between reptiles and mammals. The more pronounced elongation in birds as compared with the lower mammals is not contradictory to evolutionary theories, which not only place birds on a later paleontologic level than lower mammals, but also show that they are a radiation from the reptile stock that does not have any bearing on the other and later class of mammals (fig. 15).

The investigations will be continued in other classes of vertebrates.

SUMMARY

1. The cervical anterior horn cells of the spinal cord of vertebrates are more voluminous than the cells in the dorsal segments.
2. The form of the dorsal cells is more elongated than that of the cells in the cervical segments.
3. Similar to the ontogenetic elongation of the motor cells of the spinal cord in man, there is a corresponding situation in the phylogenetic scale of vertebrates. The relation of the longitudinal (caudocranial) to the transverse diameter of the cells in the dorsal segments increases gradually in favor of the longitudinal diameter, until in man the latter is finally three times as long as the transverse diameter.
4. The sequence in this process of elongation of the anterior horn cells of vertebrates is: amphibia—reptilia—pisces—(aves)—carnivora—rodentia—man.

ACUTE POLYNEURITIS WITH FACIAL DIPLEGIA *

HENRY R. VIETS, M.D.

BOSTON

The various types of polyneuritis may be classified in many ways. Usually, cases have been described from either the clinical or the pathologic point of view, but it seems best, with our extended knowledge of the causes of this large group of cases, to limit our groupings as far as possible on an etiologic basis. Harris¹ has done much to clarify our view on the subject by making five general groups as follows:

1. External poisons (lead, alcohol, etc.).
2. Autotoxemic (diabetes, beriberi, etc.).
3. Infective (diphtheria, typhoid, etc.).
4. Cachectic (chronic anemia, malignant disease, etc.).
5. Familial (certain muscular dystrophies).

In addition to the usual motor and sensory paralysis of the extremities, generally symmetrical, involvement of the cranial nerves may be found in many of these various types. However, if we limit the cranial nerves to the seventh pair, we find that most of the cases fall into Harris' third, or infective, group. Limiting this group still further, we find that there is a type of infective polyneuritis, called by various names, in which the facial diplegia is one of the outstanding signs of the disease. On the other hand, it should be emphasized that facial involvement may appear in many other types of polyneuritis. It has been described by Harris and others as occurring in alcoholic, lead, diphtheric and puerperal cases, also in cases of polyneuritis following influenza and in certain other groups. The type of case, however, that is described in this paper always shows a bilateral facial paralysis as one of the essential features of this particular syndrome.

REPORT OF CASES

The following case reports illustrate both the mild and the more severe, and often fatal, types of the disease:

CASE 1.—*History*.—W. E. W., aged 61, was first seen, May 4, 1925, on account of general weakness and facial palsy. The present illness began April 21, following three days of exposure to cold and rainy weather on an automobile trip. The first symptom was aching of the legs followed by pain in the lower extremities

* From the Neurological Department, Massachusetts General Hospital.

* Read at the Fifty-Second Annual Meeting of the American Neurological Association, Atlantic City, N. J., June, 1926.

1. Harris, Wilfred: *Neuritis and Neuralgia*, New York, Oxford University Press, 1926.

severe enough to keep him awake at night. He was able to work until April 29, when the sensory disturbances gave way to motor weakness. Two days later he noticed the facial palsy and, at about the same time, most of the pain in the legs disappeared.

Physical Examination.—The patient was able to walk, but with marked weakness, and he swayed in Romberg's position. The expression was blank, due to a bilateral paresis of the seventh cranial nerves. Elevating the eyebrows, closing the eyes and moving the corners of the lips were all performed weakly. The other cranial nerves were normal. The arms showed no paralysis, anesthesia, abnormal reflexes or ataxia. The abdominal reflexes were equal and active. The systolic blood pressure was 160; diastolic, 90; the heart and the abdomen were normal. The legs were weak, especially the muscles near the pelvic girdle. There was no foot drop. The knee and ankle reflexes were not obtained. There was no clonus and no response on plantar stimulation. Tactile sensation in the legs seemed slightly disturbed, although the response to the tuning fork and to the sense of position of the great toe was normal. There were no tremors. Speech was slightly thick.

Course.—The patient remained in bed three weeks. Dull pains in the legs continued to bother him, and the legs were so weak that he was just able to get in and out of bed himself. During the next three months the pain gradually disappeared, although occasionally he had a few sharp twitches in the legs. He also felt, at times, as if there were something crawling under the skin. The arms were not affected. Eating was troublesome because the food lodged between the cheek and gums, especially on the right side; occasionally it worked out of the mouth or a little saliva escaped. The patient was easily fatigued and moved slowly, at times with great effort. He became less ambitious to work, and he felt that he would never be able to resume his former activities. Abnormal sleepiness, of a slight degree, was a symptom. If he did not force himself to get up, he would easily sleep until noon, and he often sat in a chair doing nothing, not even reading, for as long as two or three hours at a time.

By Dec. 11, 1925, eight months after the onset of the illness, the patient appeared nearly normal. There was still some dulness of expression about the corners of the mouth, but not around the eyes. He walked slowly, but without loss of the associated reflexes of the arms. He took off his coat easily and rapidly. The arms were normal. The knee and ankle reflexes had returned, although the knee reflexes were slightly unequal. The patient walked with a little hesitation, although he was neither ataxic nor spastic. He seemed a little sluggish mentally.

He continued to improve, and six weeks later the only complaint was a little discomfort in the legs, but no pain. Saliva and food no longer escaped from the mouth, and normal strength and ambition to work had returned. Examination, at this time, gave nearly negative results. There was a slight slowness to faradic stimulation of the muscles at the corners of the mouth. The patient returned to his former occupation a month later.

Treatment consisted of rest in bed during the acute stage with avoidance of overstretching the muscles, and later general massage and exercise for the arms and legs with faradic stimulation to the facial muscles.

CASE 2.—History.—L. P., aged 43, entered the Massachusetts General Hospital, April 15, 1925. Two months and a half before admission he had a chill followed by fever, with considerable sweating, generalized aching and headache. He was in bed two days. On the third day he had a "full feeling" in his stomach and vomited. After he had been up five or six days, he had pain in the toes of

both feet, lasting a week, and then was apparently cured by massage and bath. Two weeks later the pain recurred, more severe, and lasted until a month before admission. At that time the legs began to seem "dead and sleepy." He gradually lost control of them. A few days later the arms became "dead," and in a day or two the left side of the face became weak, and he could not close the left eye. The next day the same thing happened on the right side of the face, and the present speech defect occurred. About this time, he lost control of the sphincters. None of the paralyses came on abruptly. It was a week before he lost entire control of the legs. At admission the only pain he had was in the muscles of the legs when touched. All the paralyses had remained nearly stationary for the last three weeks. His greatest weight had been 170 pounds (77.1 Kg.). He thought he had lost 5 or 10 pounds (2.5 or 4.5 Kg.) during his illness.

Physical Examination.—The patient was well nourished, weighing 128 pounds (58 Kg.), with evident muscular disability. The gag reflex was present. The heart was normal. The pupils were pinpoint, slightly irregular. The left reacted poorly to light; the right, not at all. The fundi were normal. There was a bilateral peripheral facial palsy, more on the left. There was some swelling over the left parotid region. The arms and legs showed marked generalized weakness. No movements of the legs were possible, but the fingers could be moved slightly. The muscles were toneless. All deep reflexes were absent. No plantar reflex was obtainable. No sensory disturbances were made out except some loss of the deep muscle sense of the toes and feet.

The urine was red at one of five examinations and alkaline at another; it showed no albumin or sugar, and a few leukocytes were found at three of the five examinations; the specific gravity varied from 1.02 to 1.006. The amount of urine varied from 35 to 62 ounces (1,050 to 1,860 cc.) when recorded. The hemoglobin content was 80 per cent; the leukocytes numbered from 3,400 to 18,600; polymorphonuclears, 60 per cent; red cells, normal. The nonprotein nitrogen on one examination was 36 mg. A blood Wassermann test was negative.

Lumbar Puncture.—Ten cubic centimeters of fluid was withdrawn on April 17. It was clear, colorless and did not clot on standing. The initial pressure was 160 mm.; after withdrawal of 5 cc., 110 mm.; after withdrawal of 10 cc., 75 mm. The pulse and respiratory movements were normal. The fluid rose to 270 mm. on jugular compression. One large mononuclear and 5 fresh red blood corpuscles were found. The alcohol test was strongly positive. The ammonium sulphate test was strongly positive. The Wassermann test was negative. The colloidal gold test was 2222333100. Chlorides were 706 mg. per hundred cubic centimeters (blood plasma, 600 mg.); sugar, 59 mg. per hundred cubic centimeters (blood plasma, 103 mg.); nonprotein nitrogen, 19 mg. per hundred cubic centimeters (blood plasma, 24 mg.); total protein, 348 mg. per hundred cubic centimeters (blood plasma, 7,082 mg.).

Course.—The temperature ranged from 97.7 to 99.9, with one rise to 102.2 on May 8. The pulse rate varied from 74 to 110. The respirations were not remarkable except for a terminal rise to 29. The patient continued to lose ground and had some difficulty in coughing, due to involvement of the phrenic and intercostal nerves. On May 15, there was extreme respiratory distress. He became very cyanotic, and was kept alive only by caffeine and the constant use of oxygen. The chest was full of râles, with signs of fluid at the right base. He died on May 16.

Gross Anatomy.—There was evidence of purulent bronchitis and hypostatic pneumonia with a soft hyperplastic spleen. The brain and spinal cord were grossly normal, except that the cord was a little more plump than usual and the

vessels were slightly injected. The pia showed one or two areas of thickening. The large vessels and sinuses were normal.

Microscopic Anatomy.—The cortex was normal. The cells forming the nuclei of the seventh nerves were normal in number, but showed marked structural changes. Only a few normal cells were seen in either nucleus. The four groups of cells that comprise each nucleus were equally involved. The cells appeared swollen and distorted, many of them having lost their polygonal form. In addition, chromatolysis was evident in nearly every cell, with occasional displacement of the nucleus, but in no case was it wound extruded. There was no vacuolation of the cells. The cells of the adjacent cranial motor nerves appeared normal. Except for the cell changes noted above, the sections through the pons and medulla showed no variation from normal.

The cells, moreover, found in the anterior horns of the spinal cord, especially in the cervical and lumbar enlargements, showed definite signs of secondary reaction in that there was some swelling, loss of Nissl granules and displacement of the nuclei. These observations were rather rare in the cervical region but were more common in the lumbar enlargement. The thoracic segments appeared normal. Throughout the cord, the blood vessels seemed to be markedly congested, although no blood cells were found in the tissues or in the perivascular spaces. The meninges were normal.

REVIEW OF THE IMPORTANT LITERATURE

Cases of a similar nature have been described by many investigators, but there are only a few outstanding reports in the literature. The first is the description of this disease by Osler,² in 1893, under the title of "Acute Febrile Polyneuritis." The condition, in his opinion, usually followed exposure to cold or overexercise and resembled that of an acute infectious disease. He says:

The temperature rises rapidly and may reach 103 or 104. There are headache, loss of appetite and the general symptoms of acute infection. The limbs and back ache. Intense pain in the nerves, however, is by no means constant. Tingling and formication are felt in the fingers and toes, and there is increased sensitiveness of the nerve trunks or of the entire limb. Loss of muscular power, first marked, perhaps, in the legs, gradually comes on and extends with the features of an ascending paralysis. In other cases the paralysis begins in the arms. The extensors of the wrists and the flexors of the ankles are early affected, so that there is foot and wrist drop. In severe cases there is general loss of muscular power, producing a flabby paralysis, which may extend to the muscles of the face and to the intercostals, and respiration may be carried on by the diaphragm alone. The muscles soften and waste rapidly. There may be only hyperaesthesia with soreness and stiffness of the limbs; in some cases, increased sensitiveness with anaesthesia; in other instances, the sensory disturbances are slight. . . . The course is variable. In the most intense forms the patient may die in a week or ten days, with involvement of the respiratory muscles or from paralysis of the heart. As a rule in cases of moderate severity, after persisting for five or six weeks, the condition remains stationary and then slow improvement begins. The paralysis in some muscles may persist for many

2. Osler, William: Principles and Practice of Medicine, ed. 1, New York, 1893, p. 777.

months and contractures may occur from shortening of the muscles, but even when this occurs the outlook is, as a rule, good, although the paralysis may have lasted for a year or more.

Osler mentions facial paralysis as one of the signs of the disease, and it seems clear that he was describing, as acute febrile polyneuritis, a condition similar to that described in the two cases reported above.

In 1908, Laurans³ collected reports of nineteen cases, some of a rather doubtful nature. In 1916, Patrick⁴ reviewed the literature to that date and added twenty-nine cases to Laurans' list, including two of his own. Neither of his cases was fatal, and he was therefore not able to throw any light on the pathology of the disease.

The next important paper on the subject was published in 1917 by Gordon Holmes.⁵ He considered that his cases showed a uniform and constant combination of symptoms, and felt, therefore, that he was justified in speaking of the disease as an entity. As the onset was usually acute and associated with a rise of temperature, he used Osler's title of acute febrile polyneuritis. Holmes had seen similar cases in London for a number of years. His article presents a group of cases, however, seen in soldiers during the years 1916 and 1917. He examined twelve patients from various parts of France, and thought that the disease was probably not more common in the army than in civilian life.

In regard to the facial nerve involvement, he made the following statement:

The face is invariably much affected from the earliest days of the illness; the facial folds disappear, the cheeks are flat and smooth, the forehead devoid of wrinkles, the lips slightly everted, and when the patient is asleep or dozing the eyes are completely covered by the lids. The face has consequently an expressionless appearance which, if once seen, cannot be mistaken. On further examination it is found that all groups of muscles supplied by the facial nerves are severely paralyzed. The patient is unable to wrinkle his forehead, frown, close his eyes firmly, blow out his cheeks, or whistle. Articulation is slurred and indistinct owing to the palsy of the lips. Fluids often dribble from the corners of his mouth if he attempts to drink and he complains that during mastication the food frequently collects between his teeth and his cheeks.

In Holmes' series, other cranial nerves were rarely involved. Diplopia occurred in three cases, and regurgitation of fluids through the nose in one or two others. Muscular paralysis was much more marked than sensory loss, although all his cases showed some hyperesthesia, and there was almost constant early disturbance of the sphincters, limited largely to difficulty and delay in starting and completing micturition. The symptoms reached their maximum develop-

3. Laurans, Aime: Thèse de Paris, 1908.

4. Patrick, H. T.: *J. Nerv. & Ment. Dis.* **44**:322 (Oct.) 1916.

5. Holmes, Gordon: *Brit. M. J.* **2**:37 (July 14) 1917.

ment quickly, generally within a week or so, followed by steady and rapid improvement within two or three weeks of the onset. Pain and hyperesthesia diminished first, followed by return of power in the muscles. Facial weakness, however, persisted for a considerable time. Two of his patients died, and he found no evidence of degeneration in the spinal roots, although the sciatic nerve in one case contained some fibers in early stages of degeneration. In the spinal cord examinations he found that the ventral horn cells were altered similarly to those found in other forms of peripheral neuritis. Some cells were slightly swollen; others showed degeneration around the nuclei. The spinal fluid in his cases, in contradistinction to my second case, did not contain excess of cells or present any other abnormal features.

Another, and perhaps the most important paper in the literature, by Bradford, Bashford and Wilson,⁶ appeared in 1918. Bradford's reports of the clinical aspects of the disease were almost similar to those of Osler and Holmes. He thinks that the cases differ in many important respects from ordinary cases of peripheral neuritis, and he feels that one is justified in recognizing them as a distinct clinical entity. He continues:

Remarkably constant bilateral affection of the face is a very striking feature of the disease, as is also the involvement of the muscles of the trunk. Further, the presence of generalized weakness rather than of actual paralysis of individual muscles or groups of muscles is very characteristic. Again, the progressive nature of the palsy and its occasional ascending character, together with the curious manner in which the proximal segments of the limbs with their large muscles are mainly involved, are all striking features in this disease and are not at any rate familiar observations in other affections of the nervous system.

He concludes that acute febrile polyneuritis is a definite entity capable of being separated clinically from other diseases of the nervous system. It is a diffuse affection of the central nervous system, affecting the spinal cord, spinal ganglia and peripheral nerves.

The pathologic and experimental work reported in this paper was done by Bashford and Wilson. They found that the disease could be transmitted experimentally from man to monkey and characteristic lesions reproduced in the experimental animal. They also thought that a living virus could be shown to be present in both the human cases and in the inoculated monkeys. Their paper is carefully illustrated, not only from the cultural point of view but also with pictures of the central nervous system lesions in both the human and the experimental cases. They describe as etiologic agents of this disease certain minute bodies grown in anaerobic tissue tubes. Their bacteriologic observations have not been entirely accepted by other bacteriologists.

6. Bradford, J. R.; Bashford, E. F., and Wilson, J. A.: *Quart. J. Med.* 12:88 (Oct.) 1918 and (Jan.) 1919.

OTHER CASES IN THE LITERATURE

Numerous cases are reported, showing that this type of disease has been partially recognized by many clinicians. Skoog⁷ describes a case of peripheral neuritis which was not quite symmetrical but in which there was definite weakness of the seventh nerve.

Many instances of recurrent polyneuritis have been described, some with facial involvement. Thomson⁸ describes a typical case of polyneuritis occurring in a patient at the ages of 5 and 19. The second attack began five days after a severe chill, and in ten days both sides of the face were completely paralyzed, in addition to the paralysis of the extremities. Targowla⁹ reports a case in which the facial nerve was involved in three attacks at the ages of 19, 27 and 39. On the other hand, there have been numerous cases of recurrent polyneuritis described in which the facial nerves were not involved. This was so in the famous case reported by Thomas¹⁰ of a patient, aged 28, who had five attacks of paralysis within six years.

It is true, moreover, that facial paralysis appears occasionally in other types of polyneuritis. Descriptions may be found in Harris'¹ report, of facial diplegia in cases due to alcohol, diphtheria and many other causes. It is especially a prominent symptom in the rare and unusual type of facial diplegia accompanied by parotitis and uveitis described by Feiling and Viner.¹¹ Similar cases following influenza are mentioned by Jelliffe.¹² Another case is reported by Sinnigar¹³ in which a patient, aged 48, had what was apparently a definite attack of influenza followed two weeks later by paralysis of the legs and somewhat later by bilateral facial paralysis. The patient recovered completely. Because of the extensive facial paralysis, it was felt that the lesion could not be nuclear but must be in a peripheral nerve.

COMPARISON OF CASES DESCRIBED IN THE LITERATURE WITH
PERSONAL OBSERVATIONS

It will be seen that the two cases described in this paper fall into the same category as those described by Osler, Laurans, Patrick, Holmes and Bradford. The first case showed mild but definite symptoms, with facial paralysis as a marked clinical feature. There was, moreover, no

7. Skoog, A. L.: *M. Clin. N. Amer.* **7**:1323 (Jan.) 1923-1924.

8. Thomson, F. G.: *Brit. M. J.* **2**:1443, 1910.

9. Targowla: *Rev. neurol.* **2**:465, 1894.

10. Thomas, H. M.: *Philadelphia M. J.* **1**:885, 1898.

11. Feiling, A., and Viner, G.: *J. Neurol. & Psychopath.* **2**:353 (Feb.) 1921-1922.

12. Jelliffe, S. E.: *New York M. J.* **108**:725 (Oct. 26), 755 (Nov. 2) and 807 (Nov. 9), 1918.

13. Sinnigar, H.: *Brit. M. J.* **2**:138, 1899.

definite history of rise in temperature, although there was exposure to adverse climatic conditions. In the second case a much more definite history of fever with an interval followed by the usual symptoms of peripheral neuritis was obtained. It is to be noted that in the second case the pathologic observations correspond roughly with the observations of Holmes and Bradford in that there were changes in the anterior horn cells suggestive of a diffuse process of the lower motor neuron rather than one entirely limited to the peripheral nerves. The emphasis, however, from both the clinical and the pathologic point of view, must be laid on the peripheral nerve as the site of the main lesion. Changes in the spinal fluid in the second case reported were of interest. It will be seen that the amount of protein was ten times normal and that there were changes in the colloidal gold reaction. This increase in the amount of protein without increase of cells suggests a degenerative process of the spinal cord. If it is admitted that an excess protein in the spinal fluid probably indicates an increase in waste products thrown off from the central nervous system, one must concede that there is inflammation or degeneration, either of the cells within the spinal cord or of the nerve roots as they pass out through the subarachnoid space, in this disease. I am not in a position, at present, to state exactly where the lesion is, but these important spinal fluid observations, not reported in other cases, would serve to indicate that a more widespread process than a strictly limited peripheral neuritis is being dealt with.

The second case, then, bears out the opinion of many neurologists that cases of this type, usually designated as acute toxic polyneuritis, acute febrile polyneuritis, acute infective polyneuritis, and Landry's paralysis, should be considered as one group. Stewart¹⁴ feels that the cases described by Holmes are not different from Landry's paralysis, and he insists that we should think in terms of neurons and not in terms of peripheral nerves in dealing with this disease. In discussing Stewart's paper, Wilfred Harris expressed the opinion that Landry's paralysis, too, is a type of multiple neuritis. Both Kinnier Wilson and James Collier thought that the term "multiple neuritis" might be a misnomer, and terms such as "neuronitis," "polyneuronitis," or "panneuronic disease" should be substituted for it.

SUMMARY

1. The two cases of acute infective polyneuritis with facial diplegia, one mild and the other fatal, conform to cases previously reported in the literature as acute febrile, or acute toxic, polyneuritis.

2. Clinically, the disease is characterized by the following features: the onset is usually acute, with fever; motor paralysis of the extremities

14. Stewart, T. G.: *Brit. M. J.* 2:461 (Sept. 12) 1925.

appears early, is seldom complete, and the proximal part of the limbs is more involved than the distal portions; sensory symptoms are mild and pass away quickly; the sphincters are often involved; the facial nerves are always involved, usually equally, and in all branches; the other cranial nerves are rarely affected; the deep reflexes are invariably lost; the disease may be fatal, but recovery takes place in the great majority of instances; complete restoration of function in nonfatal cases is to be expected within one or two years, although slight facial weakness, especially of the lower branches, may be permanent.

3. Facial diplegia is the most characteristic sign of this disease. It is rarely complete, but there is practically always inability to close the eyes.

4. The spinal fluid is altered, at least in the severe and fatal cases. The total protein content may be increased to ten, or more, times normal, without other changes in the fluid.

5. Pathologic examination discloses marked secondary changes (chromatolysis) in the anterior horn cells of the spinal cord and in the facial nerve nuclei. In the one patient examined no meningitis, encephalitis or perivascular infiltration was found.

6. The disease affects the whole lower motor neuron and should more properly be referred to as polyneuritis.

DISCUSSION

DR. HUGH T. PATRICK, Chicago: I reported one of these cases to this association twelve or fifteen years ago. It was typical except that there was no spontaneous pain. Of course some types of multiple neuritis are painless. The girl had complete facial diplegia and recovered completely. Not long after that I saw what I considered another typical case exactly like the first one, and I gave a favorable prognosis. That patient died. So it is some relief (an unkind thing to say) to hear of Dr. Viets' case. I thought perhaps my case had been one of poliomyelitis. In the necropsy, nothing abnormal was seen, and the microscopic examination never was made.

DR. HERMAN H. HOPPE, Cincinnati: Are there cases of this kind that are limited to the facial nerves? During the last two years I have seen two cases of facial diplegia without involvement of the extremities, with no improvement for the first three or four months. One patient has made a complete recovery.

DR. HARRY C. SOLOMON, Boston: I can add one rather similar case that I saw after recovery. A young woman, after childbirth, had a complete neuritic syndrome, with paralysis of all four extremities with facial diplegia, involvement of the eye muscles, complete lid drop and a Korsakoff syndrome. She made a complete recovery, with the exception of a little loss of memory and contracture of the Achilles tendon.

DR. E. W. TAYLOR, Boston: I have seen six or eight patients whose condition was characterized, as in Dr. Viets' second case, by more or less extensive paralysis of the extremities and fairly complete paralysis of both facial nerves. In several of these instances, two of which I recall distinctly, the paralysis of the body muscles was complete, such as may occur, for example, in a severe

alcoholic neuritis. The recovery in the patients I have seen has been complete, with the exception of a slight continuing disturbance in the facial nerves. This apparently is a distinctive symptom-complex characterized by a strong tendency to recovery, but with a more or less marked persistence of facial paralysis.

DR. HENRY R. VIETS: Facial paralysis has often been described in different types of neuritis other than the one I spoke of. In the alcoholic cases, and in some of the other forms as well, a facial palsy is found. Dr. Solomon speaks of a case of this type, and there are a number of similar reports in the literature.

There are also described cases of bilateral facial paralysis alone. Whether they fall into the same category or not I cannot say. There have never been any postmortem examinations in these cases. We have seen, however, recurrent attacks of Bell's palsy, bilateral in type, which seemed to be a little different from the case that I am describing.

Clinical and Occasional Notes

THE INTRAVENOUS USE OF MERCURIC CYANIDE IN TERMINAL GENERAL PARALYSIS

HOWARD K. PETRY, A.B., M.D., WARREN, PA.

What, if any, specific treatment shall be given to the far advanced and practically hopeless cases of general paralysis that come under his care is one of the perplexing problems confronting the physician in a large hospital for the insane. Experience has shown that the various arsenicals, whether administered intravenously or intraspinally, are of little if any curative value in the late stages of neurosyphilis of the paralytic type.¹ Tryparsamide, sulpharsphenamine and other drugs, which seem to have been of some value in combating neurosyphilis of the general paralytic type, are recommended by those most experienced in their use as promising good results only in the earlier cases. In large institutions for the insane in which there are likely to be hundreds of cases of late neurosyphilis and in which the funds are always limited, it is a serious question whether the expenditure of time and money necessary for the routine administration of these drugs is warranted by the results obtained. As recently as 1921, a questionnaire sent to the publicly supported hospitals for the insane revealed that 36 per cent were not giving any treatment to neurosyphilitic patients and only a small part of the remaining 64 per cent were trying to carry out any systematic form of treatment.²

At the Warren, Pa., State Hospital, it has been the custom for the last seven years in the far advanced cases of general paralysis to administer a mixed treatment of intravenous mercuric cyanide supplemented by potassium iodide. Meanwhile, all other well recommended forms of treatment were carried out in selected groups of cases of the more favorable type, and only in the cases of long standing showing marked neurologic changes or mental deterioration indicative of extensive pathologic lesions was the treatment solely with mercuric cyanide. The feeling of the staff of the hospital during that period has been that while this treatment did not modify the life tenure materially it did aid in preserving the general health of the patient and in preventing those disagreeable accompaniments of terminal paresis, decubiti and contractures.

The following comparative study of the hospital case records was undertaken in an effort to determine whether the actual facts would correspond with the impressions of the staff, and two groups of fifty cases each were gathered from the files for the purpose of comparison. In the selection of the

1. Stewart, J. P.: *Brit. M. J.* **2**:621 (Oct. 7) 1922. Read and Paskind: *Treatment of General Paralysis*, *Arch. Neurol. & Psychiat.* **11**:740 (June) 1924. Stokes, J. C., and Wilhelm, L. F. X.: *Tryparsamide in the Treatment of Neurosyphilis*, *Arch. Dermat. & Syph.* **11**:579 (May) 1925. Neymann and Singleton: *Therapeutic Results with Tryparsamide*, *J. Nerv. & Ment. Dis.* **64**:144 (Aug.) 1926.

2. Ross, J. R.: *More Accurate Diagnosis and Intensive Treatment of Syphilis*, *State Hosp. Quart.* **6**:503 (Aug.) 1921.

cases, the following criteria were observed: All must be unquestioned cases of neurosyphilis of the general paralytic type, diagnosed as such on the basis of the physical and mental symptoms. This was further confirmed by laboratory studies of the blood and spinal fluid. All the patients must have remained residents in the hospital until death.

The first group of patients, all of whom died in the hospital seven or more years ago, had not received any specific treatment. The second group did not receive any specific treatment after coming to the hospital, except a routine course of intravenous injections of a solution of mercuric cyanide, $\frac{1}{2}$ grain (13 mg.), in 5 cc. of sterile distilled water three times a week for a period of six weeks. This was followed by the daily oral administration of 30 minims of a saturated solution of potassium iodide for a period of four weeks, followed by a rest period of two weeks. This course was repeated as long as the patient remained in the hospital. Spinal drainage was employed every three months for the purpose of obtaining diagnostic specimens rather than for any therapeutic effect.

The statistical data of the group studies are given in the accompanying table.

Comparative Statistics in a Group of Fifty Treated and Untreated Patients

	Untreated Patients		Treated Patients	
Average age at primary infection.....	15	24.9 years	17	25 years
Average age at onset of mental symptoms.....	48	44.7 years	49	39.9 years
Average age on admission.....	50	46.6 years	39	41.4 years
Average age at death.....	50	47.4 years	49	42.7 years
Number having a period of real mental improvement *	6	12 per cent	6	12 per cent
Number showing marked emaciation at death.....	19	38 per cent	20	40 per cent
Number having decubiti.....	12	24 per cent	3	6 per cent
Deaths from infections.....	7	14 per cent	1	2 per cent
Deaths from convulsions.....	11	22 per cent	16	32 per cent
General paralytic deaths †.....	32	64 per cent	33	66 per cent
Average number of months in which bed care was required		4		7.5

* A remission that would warrant return home under reasonable supervision is considered as a period of real improvement.

† By general paralytic death is meant death from general debility accompanied by myocardial failure.

The records in the older group of patients did not give the degree of contractures observed, although physicians who were on the staff at that time report from memory a fairly high incidence. Contractures have not been observed in the treated patients.

Several points are apparent from the figures given. The average incubation period has decreased nearly five years in the second group. Admission to the hospital occurs almost five months earlier in this group, probably owing to earlier recognition and better understanding of the disease by the profession at large. The expectancy of life from the onset of mental symptoms has not been modified. There has been a marked reduction in the incidence of decubiti, contractures, and deaths from infections in the treated group, in spite of the fact that the bedridden period in the treated group has almost doubled. The last may be accounted for in part by the fact that, for the purpose of cleanliness and ease in caring for patients, it has been the custom during the last few years to keep all untidy patients in bed. In my opinion, decrease in infections, decubiti and contractures cannot be explained on the basis of superior

nursing care given to the second group. In fact, the earlier group was cared for at a time when the nursing personnel was almost double that employed for the second group and when the type of attendants was, if anything, superior.

An increased number of remissions has not been observed in treated as compared with untreated patients. Marked serologic changes have not been observed in the treated group; but the general health of patients in this group has been better, and there has been a marked reduction in trophic disorders and infections in spite of a longer bedridden period.

The use of mercury in one or another form in the treatment of syphilis does not need any explanation. With the advent of the various arsenicals there has been, I believe, a tendency to abandon this drug which for centuries was the chief therapeutic reliance in the treatment of syphilis. It is interesting to note in this connection the recently expressed opinion of Nonne³ to the effect that it must be admitted that the therapeutic results with arsphenamine in cerebrospinal syphilis, tabes and general paralysis have not been materially different from those previously obtained with mercury and iodides.

Mercuric cyanide was chosen for this treatment for several reasons: It is high in mercury content, approximately 80 per cent; its solubility in water is great, 1 to 13, and it is strongly bactericidal. The solutions for intravenous treatment were prepared in our laboratory, in bulk, by dissolving chemically pure mercuric cyanide in sterile distilled water in such proportions that 1 cc. of solution contained $\frac{1}{25}$ grain of mercuric cyanide.

It was demonstrated, experimentally, that women could tolerate 3 cc., or $\frac{3}{25}$ grain of this preparation three times a week in practically all cases, while men could tolerate about 5 cc., or $\frac{1}{5}$ grain, three times a week without showing symptoms of mercurial poisoning. Increase in this dosage, however, was followed in a number of cases by salivation or mercurial stomatitis.

Mercuric cyanide thus prepared is inexpensive. Because of its bactericidal properties it remains sterile; it can be boiled if desired. It is simple to administer and does not produce any untoward reactions, except in excessive dosage when symptoms of mercurialism are noted. In more than 5,000 injections administered at the Warren State Hospital, systemic reactions have not been noted, and only a half dozen cases of severe local reaction have been observed when an error in technic or poor veins allowed the escape of a considerable portion of the fluid into the perivascular tissue. These few local reactions have been marked by pain, swelling and the development of a sterile slough. The drug has never been observed to produce marked disturbance in the kidneys, and a careful study of the kidney function in five cases, in each of which more than fifty injections had been given, did not show any departure from normal.

I therefore suggest the use of intravenous mercuric cyanide as a safe, economical and easily administered treatment in hopeless cases of general paralysis that might otherwise remain untreated. This is recommended not in any hope of curing or markedly modifying the course of the disease, but to contribute toward the physical welfare and comfort of the patients during the terminal period. It would seem also, that this method is a satisfactory one for the administration of mercury in any case requiring prolonged treatment with this drug. The dose can be measured accurately and the gastro-intestinal disturbances attendant on administration by mouth, the disagreeable features of inunctions, and the pain of intramuscular injections can be avoided.

3. Nonne, M.: Treatment of Late Syphilis and Metasyphilis of the Nervous System, *Ztschr. f. d. ges. Neurol. u. Psychiat.* **95**:335 (March) 1925.

TECHNIC FOR OBTAINING BLOOD FROM THE INTERNAL JUGULAR VEIN AND INTERNAL CAROTID ARTERY

A. MYERSON, M.D., R. D. HALLORAN, M.D. AND
H. L. HIRSCH, M.D., BOSTON

While a method of injecting therapeutic solutions into the internal carotid artery so that these substances might reach the brain directly was being worked on, the technic broadened out into a new method of studying the metabolism of the brain. It seemed theoretically correct that if one could study the blood directly before it reached the brain, and then could study it directly as it came from the brain, without admixture with venous blood from other parts of the body, something might be learned of what takes place within the brain. In order to accomplish such a study, it is desirable to obtain blood from the internal carotid artery (although, theoretically, any arterial blood would be of the same constitution), but it would be necessary to get blood from the internal jugular vein before it receives branches from the face and the neck. We found it possible to do this, without cutting down on these vessels, by the use of the ordinary Wassermann needle and the Luer syringe. Though the technic is without danger, it looks formidable; however, it is easily learned and entirely practicable.

In order to exclude air from the blood, it is collected in a syringe which has been moistened with liquid petrolatum, and contains a few drops of oil in the needle. The juncture between needle and syringe is moistened with oil to make it air tight. We have not found it necessary to put citrate or oxalate in the syringe to prevent the blood from clotting. If the artery and vein are properly punctured, from 20 to 30 cc. can be collected before clotting takes place.

We believe that the collection of blood from the internal carotid artery and the internal jugular veins is a practicable and safe method of studying brain metabolism. Together with a spinal fluid examination, it seems, theoretically, a complete method for this purpose.

Anatomy.—High in the neck, near the tip of the mastoid and between it and the angle and vertical ramus of the jaw, the internal jugular vein and the internal carotid lie near each other, the artery internal to the vein, and about on the same plane. The pneumogastric nerve lies lower than the vessels, between them, and other nerves (the ninth and twelfth) pass between the vessels. One need not be afraid of injuring the nerves in any puncture proceeding, for they are apparently pushed aside if one misses the vessels without the slightest evidence of injury. Nor does puncturing the walls of the two large vessels do any harm, as we have assured ourselves by open inspection after repeated punctures.

Technic.—The patient lies on his back with the head turned as far as possible toward the shoulder opposite the vessels to be punctured; that is, he looks to the left if the right vessels are to be used, to the right if the left vessels are to be used. The skin of the tip of the ear, the jaw, the mastoid region and the upper neck is sterilized with iodine. Under aseptic precautions the needle attached to a syringe is introduced.

To obtain blood from the internal jugular vein, the needle is introduced at about the level of the tip of the mastoid process, along the margin of the sternocleidomastoid muscle, and perpendicularly. To obtain the blood from the internal carotid the needle is introduced a short distance (about 1 cm.)

internal to this and at a slight angle from the perpendicular. It is more difficult to puncture the carotid artery than to puncture the jugular vein. In both instances, the needle is usually introduced almost its entire length, and then gradually withdrawn with gentle suction by the syringe until blood flows into the barrel.

Comment.—At the suggestion of Dr. William Lennox, we take a sample of the spinal fluid immediately after obtaining the samples of blood, so that in our present study we obtained samples of the blood going to the brain and of the two accessible fluids in which metabolic brain products might be expected to be present, the internal jugular venous blood and the cerebrospinal fluid. Theoretically, a cistern puncture might be more appropriate, but, except under conditions of block, the differences between the cerebrospinal fluid obtained by cistern puncture and that obtained by lumbar puncture are slight.

It seems to us that not only is this an entirely practical method for the study of brain metabolism, but that the results of disease processes within the brain might be ascertained in some measure by jugular and carotid puncture. Changes that become too diluted when median basilic blood is studied might be present in discoverable measure when blood is taken directly from the internal jugular vein.

News and Comment

BRITISH-AMERICAN NEUROLOGICAL MEETING

A combined meeting of the Neurological Section of the Royal Society of Medicine and the American Neurological Association will be held in London, at the House of the Royal Society of Medicine, 1 Wimpole Street, W.1, on July 26, 27 and 28, 1927.

TENTATIVE PROGRAM

TUESDAY, JULY 26; 9:30 A. M., SHORT PAPERS

2:00 P. M., SHORT PAPERS

WEDNESDAY, JULY 27, 9:30 A. M., DISCUSSION ON THE CEREBELLUM:

1. DR. FREDERICK TILNEY and DR. H. A. RILEY: "Comparative Morphology."
2. DR. L. J. POLLOCK and DR. L. DAVIS: "Physiology."
3. DR. AUBREY T. MUSSEN: "Experimental Results."
4. DR. HARVEY CUSHING: "Surgery."
5. DR. T. H. WEISENBURG: "Clinical."

To be discussed by DR. JAMES COLLIER, DR. GORDON HOLMES, DR. F. M. R. WALSHE and MR. WILFRED TROTTER.

2:30 P. M., SPECIAL CLINICAL MEETING

THURSDAY, JULY 28, 9:30 A. M., DISCUSSION ON SENSORY DISORDERS IN ORGANIC DISEASE OF THE NERVOUS SYSTEM:

1. PROFESSOR J. S. B. STOPFORD: "Sensory Disturbances following Division and Suture of a Peripheral Nerve."
2. DR. GORDON HOLMES: "Sensory Disturbances Due to Spinal and Brain-Stem Lesions."
3. DR. WILFRED HARRIS: The Same.
4. DR. S. A. KINNIER-WILSON: "Certain Dysaesthesiae and their Neural Correlates."

2 P. M., PAPERS AND DEMONSTRATIONS ON PATHOLOGICAL SUBJECTS

5 P. M., DR. CHARLES L. DANA WILL DELIVER THE HUGHLINGS JACKSON LECTURE

BRITISH MEDICAL ASSOCIATION

The annual meeting will be held in Edinburgh, Scotland, on July 19 to 22, 1927, inclusive. It will be the occasion of the centenary celebration of the birth of Lister. Dr. Edwin Bramwell, 23 Drumsheugh Gardens, Edinburgh, is the chairman of the neurological section. A cordial invitation has been extended to American neurologists to attend.

MEETING OF MISSOURI-KANSAS NEUROPSYCHIATRIC SOCIETY

The Missouri-Kansas Neuropsychiatric Society met at State Hospital no. 2, St. Joseph, Missouri, April 13, 1927. Doctor T. H. Romeiser presented a case of late encephalitis epidemica with a torsion spasm. Doctor H. O. Daniels presented a case of parkinsonian syndrome, following encephalitis. Doctor J. H. Parker presented a case of multiple sclerosis, with spastic paraplegia. Major Edgar King, U. S. A. Disciplinary Barracks, Fort Leavenworth, read a paper on "The Commoner Mental Defects and Disorders, and their Detection in the Selection of Recruits."

Abstracts from Current Literature

THE "PASSAGE OVER THE FLUID." PART I. (AMPLIFICATION AND DEFENSE OF MY THEORY OF METASYPHILIS.) ALFRED HAUPTMANN, *Ztschr. f. d. ges. Neurol. u. Psychiat.* **102**:325 (May) 1926.

Hauptmann, in 1921, advanced a theory concerning the pathogenesis of metasyphilis, which in brief was that the local presence of spirochetes in the nervous substance was not sufficient to explain its development. In addition to the local harmful influence of the spirochetes on the brain and cord, there is also a toxic component which has its origin in the presence of the spirochetes but which exerts its influence over the entire body. Further reflection has thrown some light on the nature of the blood-fluid barrier which is of importance in the development of the theory.

In metasyphilis there are certain clinical and anatomopathologic facts that are unexplainable on the basis of the local presence of spirochetes alone. What are the facts? In the first place, there is the stiff pupil. If Bumke's theory, that the part involved is the small territory of reflex fibers between the end of the optic fibers in the midbrain and the oculomotor nucleus is accepted, it is difficult to understand how one gets a limitation of the spirochetal process to such a small area and why there is the predilection for this area. Moreover, it is usually the pupil that is involved, with involvement of the oculomotor nucleus more rarely. Why then, if their presence locally causes a stiff pupil early in tabes, do they not wander over into the brain and cause a general paralysis? Its occurrence through the influence of toxic substances is more readily explainable, especially in view of the fact that alcohol and diabetes can produce similar results. What probably occurs is an infiltration of toxic substances from the ventricular fluid into the brain substance involving more particularly the tracts and nuclei bordering on the ventricle. Ingvav, in a recent study of the phylogenesis of the midbrain, has pointed out the superficial position of the paths containing the pupillary fibers and wonders whether the isolated loss of the light reflex in a slowly progressive process could not be explained by this fact.

Another fact difficult to explain by the local effect of spirochetes is the tabetic process in the dorsal root. Its systematic nature cannot be explained by the local presence of spirochetes in Nageotte's area. As Lichter believes, Spielmeyer has stated that the histologic changes in this do not explain the loss of fibers. Schaffer also recognizes, besides the unsystematic degeneration at the local area containing spirochetes (Redlich-Obersteiner area), a systemic degeneration which is explained in part by the embryologic development of the tracts and in part by the elective effect of the spirochetal toxins. Jakob brings evidence to bear also in favor of Hauptmann's view. He investigated the degeneration of endogenous tracts in general paralysis (oval bundle of Flechsig) as well as degeneration in the descending tracts, and concluded that it was impossible to explain these changes by the local effects of spirochetes, and that they must be looked on as primary degenerations similar to other systemic diseases on a syphilitic basis (spastic spinal paralysis). The difficulty lies in the fact that no cases have been seen with both the inflammatory and the degenerative changes isolated so that it is possible to say whether one follows from the other. Spielmeyer found that in sleeping sickness, despite severe

cellular injury in the dorsal roots, evidence of a tabetic disease was lacking, while in other forms of trypanosomiasis, e. g., nagana, in the dog, pure dorsal column degeneration without meningeal inflammation occurred.

Optic atrophy in metasyphilis must also be looked on as a toxic degeneration rather than the result of a local effect of spirochetes. If the latter occurs, why do the spirochetes so rarely wander into the cortex and produce general paralysis? Also, why is optic atrophy so rare in general paralysis when the cortex is saturated with spirochetes? How, except by a systemic degeneration can the combination of optic atrophy and degeneration of the dorsal column be explained? Here it must be pointed out that spirochetes have never been found in the optic tract but only about it. Igersheimer has found spirochetes in the meninges and near the optic tracts without optic degeneration. He found it hard to explain how toxic effects worked in one case and not in others. The same objection may be made here as in tabes; namely, that it is hard to find cases showing the inflammatory and degenerative processes isolated. Fujiwasa studied nineteen cases of optic atrophy in tabes and general paralysis and found severe atrophy with slight inflammatory changes and vice versa. It seems, therefore, improbable that optic atrophy is the result of the local effect of spirochetes.

The occurrence of tabetic psychoses and acute hallucinatory excitements in these cases is hard to explain also on the local effect of spirochetes. In Fournier's cases of parasyphilitic epilepsy occurring in syphilitic persons previously free from epilepsy and followed later by signs of tabes, the explanation by local effect is untenable. The same is true of the paranoid form of cerebral syphilis (due to a syphilitic endarteritis) and syphilitic hallucinosis. They are due not to a local effect, but to the combination of a localized spirochetal process and a general toxic state.

From the biologic standpoint, Hauptmann has shown that the patient who has developed a metasyphilitic condition is an organism weak in immune bodies. The possibilities of less virulent spirochetes and of the descendants of spirochetes being less capable of forming immune bodies present themselves. Stuhmer has found in experiments on dogs infected with trypanosomiasis that the offspring when injected with the original strain and with the strain recovered from the mother ran the usual course of the disease in the first instance and in the second developed a septic-like process because their resistance was weak. Syphilitic persons who later develop metasyphilis are comparable with these animals weak in immunity. Hauptmann rejects the old conception of a strain of spirochetes with special affinity for the nervous system. He is more in favor of the view that in every case in the secondary stage the spirochetes are spread throughout the body and hence in the nervous system. Constitution and strain of spirochete are not to be looked on as independent factors, but rather as depending on one another, since the virulence of a spirochete can be shown to be weakened by passage through a body strong in immune reactions. Insufficient therapy is another factor in the occurrence of metasyphilis, acting through a change in virulence of the spirochete and an inability of the body to protect itself. The occurrence of metasyphilis, however, is due not so much to the relations of immunity of the nervous substance as to the insufficient defense factors from the secondary stage on. In the receding of skin symptoms in the secondary stage, nervous symptoms become more plentiful. How do metasyphilitic persons differ from the normal in their defense measures? The body strong in immune bodies wards off the spirochetes through its skin reaction, destroying them by phagocytosis (Bandi, Simonelli, Levaditi, Lowen-

thal, Mulzer et al). The body weak in immunity is unable to do this, as evidenced by the lack of signs of skin involvement. It acts in another way, however. It digests the spirochetes as albuminous matter. This occurs not in the cell but in the tissues—the blood stream. By means of this digestion albuminous products occur—anaphylatoxins. Proof of this is found in the large amount of proteolytic ferments in the blood of general paralytic patients. Further evidence is found in the similarity of the attacks in general paralysis to those in anaphylactic cases, also in the low temperatures, fatty changes in the musculature, and changes in the kidneys and liver due to metabolic disturbances. Digestion of the spirochetes occurs not only in the nervous system but also everywhere in the body, and in this sense the finding of spirochetes in the brain is important. These effects of anaphylatoxins on the nervous system can be demonstrated pathologically. Rachmanon found changes in the ganglia, glia cells, and fibrils of animals. Weinberg found perivascular infiltration, and Schröder found infiltration and cell changes. Still more important is the occurrence of changes in the endothelial cells of the capillaries and the cerebral vessels which cause an increased permeability.

Gerstmann has recently pointed out that during malarial treatment the clinical picture of general paralysis may change to an hallucinatory-paranoid form. Hauptmann says that this occurs also in other forms of treatment, with rapid death of spirochetes. Gerstmann thinks this is due to a change from general paralytic process to a primary syphilitic process, and does not think it is due to the spread of toxins in Hauptmann's sense. Hauptmann, on the other hand, feels that these observations support rather than contradict his view, and goes at some length into the controversy. Kirschbaum, in examining the brains of patients who died during or soon after malarial therapy, never found spirochetes, even in patients who shortly before death had had epileptic attacks and periods of excitement. He asks, therefore, whether Hauptmann's toxic theory is not correct. Hoff and Silberstein have recently shown how the spirochetes are destroyed by the spinal fluid during a malarial cure. They investigated the effect of the spinal fluid on spirochetes in such cases by means of the dark field, and found that motility soon ceased in spirochetes that were in the fluid of cases in which treatment was given, while no such phenomenon occurred in the fluid of cases in which treatment was not given. Hoff and Pollak made experimental studies on guinea-pigs in which after trephining they injected paralytic fluid under the dura. Simultaneously with the clinical phenomena occurred a change in the fluid—increased cell count and globulin, and the colloidal gold curve of paralysis. All these changes remained after several months' observation. Histologically, two types of changes occurred: those in cases in which the degenerative changes in the ganglion cells were most pronounced while the infiltration process was slight, and vice versa. In the first type the cells of the cortex and the cord were severely injured; the glia cells were increased; the vessels showed thickening and intimal proliferation, and the cells of the oculomotor nucleus were injured. They concluded that one "must recognize in the spinal fluid a very active factor in the production of parietic brain disease." They believe the fluid contains toxins, and that the presence of spirochetes is not necessary for the production of severe histologic changes in the brain, but that a toxic effect can produce the results quoted. They, therefore, come to the same conclusion in their experiments as Hauptmann does in his theory. Hauptmann lays stress on the rôle of phagocytes and lymphocytes in destroying the spirochetes in the secondary stages. Ehrmann says that phagocytes are one of the most important defenses against syphilis,

and thinks that the malignancy of syphilis in cachectic persons and in drinkers may be due to a diminished ability of their cells to undertake phagocytosis. Hauptmann believes that if there is a skin reaction there is phagocytosis, and if not there is none, as in paralytic and other metasyphilitic patients. According to Hauptmann, therefore, the general paralytic process begins in the secondary stage, but it takes a long time for the development of a toxic disturbance in the nervous system because of the blood-fluid barrier. Hoff and Silberstein found that in the course of malarial treatment there was a great increase in bacteriotropins for staphylococci, streptococci and colon bacilli in the serum, and that phagocytosis can be seen in the dark field if one brings together spirochetes, fluid and leukocytes from patients who have been treated but not from those who have not received treatment. The general paralytic body is therefore weak in immune bodies, and this is rectified by the malarial cure. Hoff and Silberstein and also Stern have demonstrated an increased permeability of the blood-fluid barrier in these cases as shown by the increased number of immune bodies in the fluid of patients treated with malaria.

The views of Hauptmann may be categorically summarized as follows 1. The local pressure of spirochetes in the central nervous system does not suffice for the explanation of all the phenomena of metasyphilis. 2. The defense reactions of the organism in the secondary stage are important in the production of metasyphilis. The organism strong in defense fights the spirochetes by phagocytosis, as shown by the skin symptoms. The body weak in defense reactions has no phagocytic powers and hence no skin reactions. 3. Strong or weak defense reactions depend not on a constitutional factor but more often on a strong or weak reaction to more virulent or less virulent strains of spirochetes. 4. Such less virulent spirochetes are probably created by the present methods of treatment. 5. The body that develops metasyphilis battles the spirochetes in the secondary stage, not by phagocytosis but by digesting them extracellularly, thus producing albuminous toxins. Such toxins have a special affinity for the nervous system and injure in particular the endothelium of the vessels. By this means an increased meningeal permeability occurs. 6. In this way also substances that injure the nervous substance pass from the blood into the cerebrospinal fluid (der "Weg über den Liquor"). 7. The decrease of the permeability in the course of malarial and other treatment of general paralysis in the clinically improved patients is a proof of the significance of this factor in the pathogenesis of metasyphilis.

ALPERS, Philadelphia.

CEREBROSPINAL SYPHILIS. GENICHI NAGASAKA, Arb. a. d. neurol. Inst. a. d. Wien. Univ. 28:291 (May) 1926.

It is now generally admitted that in cerebrospinal syphilis the meninges are the site of attack for the syphilitic virus, and that the meningeal involvement is the result of the infectiousness of the cerebrospinal fluid. The spirochetes, as has been shown by Marburg, enter the adventitious lymph spaces; whence they invade the cerebrospinal fluid and infect the meninges. The meningeal infection may exist for many years without the slightest clinical manifestations. On the other hand, symptoms of cerebrospinal syphilis may appear relatively early—a few months after the primary infection; some of these cases terminate fatally and show at necropsy a severe meningitis with the inflammatory process extending to the parenchyma. Nonne has shown that the manifestations of neurosyphilis are predominately caused by a combination of various syphilitic products (?) and that it is this association of manifestations that constitutes an important diagnostic criterion in neurosyphilis. This naturally raises the

question of how a latent meningitis can become active and what are the factors that bring about this change—usually so deleterious to the patient. Nagasaka had occasion to examine six patients, in all of whom apparently chronic meningitis had existed for many years without disturbing the patients very much, until, without warning and suddenly, there appeared alarming clinical symptoms that led rapidly to a fatal termination. The patients having the disease were in or about the sixth decade of life—an age at which vascular disease may be said to be the rule. In this group the vascular processes showed considerable variations; there were evidences of syphilitic as well as of senile vascular processes. The meningeal process was predominatingly one of chronic productive inflammation; the more recent lesions were found only on the outer surface of the pia; when infiltrates were present they were lymphocytic in nature. The roots were surrounded by fibrous tissue with their margins full of infiltrates which, judging from the appearance of the axis cylinders, had not injured the roots. The intense meningeal process alongside apparently uninvolved parenchyma presented a striking and characteristic pathologic process. The typical change in the vessels was a mesarteritis; in some cases the meningeal process extended to the adventitia with comparatively little involvement of the intima, whereas in other cases marked changes were found in the intima. The endarteritis led to almost complete vascular obliteration. Some cases showed endarteritis, mesarteritis, periarteritis and adventitial infiltrates alongside typical arteriosclerotic and atheromatous changes with marked calcification. The meningeal infiltrates were found to invade the parenchyma only along the vessels; occasionally the infiltrate would change its character and form a gummatous process; this, however, was not common. Any change in the parenchyma, whether malacia or disintegration, was always perivascular.

In addition to the vascular and meningeal changes in the brain, every case presented evidences of severe aortitis and cardiac involvement. Confirmatory evidence of primary infection of the cerebrospinal fluid was found in the ependyma. This membrane showed a proliferating process in every case; the involvement was evident in the third and fourth ventricles but reached its greatest intensity in the ependyma of the lateral ventricles. The vascular changes in the ependyma, however, were not severe enough to justify regarding the ependymitis as an inflammatory process. Every case showed an unusually large number of corpora amylacea.

A correlation of the clinical and anatomic signs revealed the following:

CASE 1.—Clinically, this case showed hemiparesis, hemihypalgesia and pupillary stiffness to light. Pathologically, there was diffuse meningitis with moderate involvement of the neuraxis; this was associated with softening in the pons involving the pyramidal tract on one side. The glial proliferation was intense, especially in the ependyma and around the aqueduct; the latter accounts for the pupillary symptoms. It is noteworthy that the paresis in the limbs appeared in 1910, and the patient was not seen in a hospital until 1923, when she attempted suicide; after this, she developed a cystopyelonephritis to which she succumbed. She had no other symptoms. It is also of note that the first clinical manifestations set in simultaneously with an attack of grip.

CASE 2.—This patient's symptoms also began with an attack of grip, during which she developed diplopia which was followed first by paralysis of the lateral gaze to the left and then upward, with marked vertical nystagmus. Later she became psychotic and developed a bulbar speech. The pathologic examination showed: chronic progressive meningitis with marked arteriosclerosis; the vessels showed intense calcification; the media seemed to carry the brunt of the

arteriosclerosis. The oculomotor nucleus was intact, but the subependymal glia was increased. The nucleus of the trochlearis was normal. One posterior longitudinal bundle showed a diseased vessel with perivascular disintegration; this accounts for the paralysis of the lateral as well as of the upward gaze.

CASE 3.—This was apparently an acute case. All that one could gather from the history was that the patient had complete paralysis of the extra-ocular muscles. Anatomically, multiple hemorrhages in the region of both oculomotor nuclei were seen. There was not any difficulty in distinguishing these hemorrhages from those of epidemic encephalitis.

CASE 4.—This case belongs to a group that is now beginning to gain more general recognition—amyotrophic spinal syphilis. The ganglion cells showed marked changes, which were entirely different from those in amyotrophic lateral sclerosis. An interesting feature in this case was that although the meninges of the pons and medulla were severely affected, the ganglion cells were relatively intact. The aqueduct was surrounded by a zone of marked sclerosis; its ependyma showed glial proliferation, but the cells of the oculomotor nucleus were relatively intact. It is impossible to state why in the presence of a more or less uniform process the anterior horn cells were in some parts severely affected and in other parts were entirely free from involvement.

CASE 5.—Except for a slight anisocoria and perhaps some disturbance in reflexes, the patient did not present any clinical manifestations. Yet, in spite of the paucity of symptoms, there was a severe chronic meningitis with a more recent meningitis over the cerebellum. The vessels also showed marked changes with perivascular disintegration.

CASE 6.—This patient suffered from severe pain in the back and showed unusually lively tendon reflexes—no other symptoms. Anatomically, marked proliferation of the pia and infiltration of the root bundles were seen; the latter probably accounts for the pains in the back, especially as the meningeal changes in the lower segments of the cord were more marked than those in the upper segments.

In conclusion, Nagasaka points out that the fatal termination in all these cases was not due to the cerebral or to the cerebrospinal process but to the involvement of the aorta and heart, and, as in one of the cases, to nephritis secondary to the disturbances of bladder control. He does not believe that these cases can be recognized clinically by the changes in the cerebrospinal fluid, because the meningeal process may be so slight, especially in the spinal cord, that there may not be any pleocytosis. The diagnosis must be made on the subjective clinical signs (pains) and the pupillary changes. These, taken in conjunction with the aortic changes, should arouse suspicion that one may be dealing with a cerebral condition consisting of meningeal and vascular changes in the vessels. This seems to be a special form of cerebrospinal syphilis which represents a transitional type between absolute latency and gummatous meningo-encephalitis with the usual changes in the vessels.

KESCHNER, New York.

CHRONIC SYSTEMATIZING COMPULSION NEUROSIS. W. JAHRREISS, *Arch. f. Neurol. u. Psychiat.* 77:596 (Aug.) 1926.

A clinical, characterologic and genetic study of a case of compulsion neurosis is presented with a discussion of the relations it bears to compulsion symptoms and the tendency to systematization in paranoia. The case is that of a man, aged 28, who presented various compulsion phenomena, analysis of which showed a

definite system originating, according to the author, in early experiences. The central point in this system, the author feels, is a series of fires that took place in the town in which the patient was born and lived up to about the age of 6 or 7. There was a definite fear reaction to these fires, and the parents moved to another town immediately after the incident. The symptoms of the neurosis began immediately after the change of surroundings, and showed themselves in fear of anything that could have any relation to the patient's first home. Mail that came from there, clothes that were worn there, etc., could not be touched without elaborate cleansing processes such as extremely careful brushing of his own clothes, incessant washing of his hands, etc. With that the gradual development of a personality in which sensitiveness, meticulous care of personal appearance and pedantic systematization of work and play were noticed.

Of an average intellectual endowment, the patient had, nevertheless, by extreme diligence and hard work managed to keep a high place in school. His high achievements there, however, were more of the theoretic type, and when he had to strike out for himself he showed inferior ability in dealing with practical problems. His sensitiveness, extreme pride and ambition suffered under these failures to achieve as high a place as he felt he deserved, and were an added stimulus toward the further development and systematization of the neurotic traits. For a brief while, at the age of 25, the patient, while under a specially difficult strain, developed a loosely connected persecution trend which, however, soon passed over to give place to the previously developed compulsions. His attempts to secure positions were not particularly successful, partly because of difficult economic situations in Germany at the time, but also because to a certain extent, the attempts were conditioned by lack of initiative and practical abilities. He came to the outpatient clinic voluntarily, his chief complaints being the various obsessions and compulsions.

The author first discusses the development of the disease and comes to the conclusion that whereas one cannot with certainty tell whether the fire incident was the origin of the disease, it seems that, in the system built up, it occupies the central position. From it the network of systematized compulsions gradually spreads to include and determine all the behavior of the patient. This, however, the author feels cannot explain the development of the disease altogether. Given such a constellation of factors, one would also have to presuppose a certain definite type of make-up as a favorable soil for the growth of such a system. Just what this make-up depends on is doubtful.

In a study of the heredity one sees on the father's side, at any rate, a tendency toward the sensitive, pedantic type of make-up which came to a height in the father and to a climax in the patient. Whether the choice of the particular type of pathologic reaction also has other determinants, such as early sexual experiences which, according to the Freudian school, are the basis of neuroses of this type, is problematic. As far as could be ascertained, the sexual life of the patient, although not quite normal, did not show any such early experiences.

The relation of the disease and its development to paranoid delusional systems is discussed. There, too, systematization occurs, but the author sees the main difference between the two types not only as quantitative (as some authors would have it) but also as qualitative. The paranoid patient systematizes with the feeling of a free will and looks on his ideas as something real and as existing outside of him. In this case, as in all such neuroses, this quality of projection is absent, as is also the feeling of voluntary reaction. The patient having a compulsion neurosis, as the name suggests, is compelled to do things, but at the same time is perfectly aware of the fact that the compulsions come from within him.

MALAMUD, Foxborough, Mass.

ENCEPHALOGRAPHY AND THE ESTIMATION OF THE PASSAGE AND RESORPTION OF FLUID IN THE ESTIMATION OF THE SO-CALLED COMMOTION NEUROSES. OTTO SCHWAB, *Ztschr. f. d. ges. Neurol. u. Psychiat.* **102**:294 (March) 1926.

It is usual to include the commotion neuroses under the neuroses that occur as a result of trauma. Recently, Redlich has taken the stand that the commotions no longer should be included among the true neuroses, since their basis consists of microscopic changes in the nervous system. Schwab has shown changes in the encephalographic picture in patients with severe and also slight head traumas. The encephalogram of such patients shows: (1) lack of filling of the lateral ventricle on the introduction of air by the lumbar route; (2) dilatation of both ventricles or dilatation and distortion of the lateral ventricles on the side of the trauma; (3) an abnormally large collection of air on the convexity of the brain with filling or lack of filling of the ventricles. Another means of investigating these cases is the examination of the passage and resorption of the spinal fluid by means of phenolsulphonphthalein (Dandy and Blackfan) or sodium iodide. The passage of the fluid is demonstrated by the introduction of phenolsulphonphthalein or 2 cc. of a 10 per cent solution of sodium iodide by lumbar or ventricular puncture and the determination of the time at which they appear in the ventricular or lumbar regions. The significance of these tests lies in the fact that there are cases in which the ventricles do not fill with air while the substances mentioned appear in the ventricular or lumbar fluid depending on where they were introduced. Foerster has been able by this means to draw a distinction between relative closure of the ventricles, when air does not pass through while chemicals do, as opposed to absolute closure in which chemicals also fail to pass. The resorption of the fluid is determined by the time interval between the introduction of the phenolsulphonphthalein or iodide into the ventricle or lumbar sac and its appearance in the urine. Normally, sodium iodide introduced in this way appears in the urine in from one to one and one-half hours after its introduction. Anything more than one and one-half hours is looked on unequivocally as pathologic. Any interval of time over one and one-half hours in the presence of normal circulation and kidneys, is looked on as indicating a disturbance in interchange between blood and cerebrospinal fluid.

By the combination of encephalography with studies on passage and resorption, important diagnostic conclusions can be reached. If, for example, encephalography shows hydrocephalus occlusus with a normal resorption rate, hydrocephalus hypersecretorius can be assumed; with decreased resorption rate it would indicate hydrocephalus areosorptivus. Studies on patients with slight traumas of the head show lack of filling of the lateral ventricles, distortion and dilatation of the ventricle on the side of the trauma, and collection of air on the surface of the brain. These patients present such features as headache, vertigo, decreased resistance, weakened memory, sleepiness, fatigability and sleep disturbances. The most important fact is that in such patients it is possible to establish definite changes by encephalography, or the passage and resorption of fluid. Similar changes are found in patients with severe traumas of the head with a difference in degree and intensity. The Wassermann reactions in the blood and the spinal fluid were negative in all cases, as were the results of examinations of the ear and caloric tests. The spinal fluid pressure was increased in one case and normal in the others. The routine examination of the fluids showed no abnormality. The objection that the changes here described may be within the limits of normal is answered by the fact that in 400 cases of encephalography in normal patients the ventricles filled sym-

metrically and there was no collection of air over the cerebral surfaces. Schwab believes that he has demonstrated the organic nature of the commotion neuroses and suggests removing them from the group of neuroses. He offers the term "encephalopathia traumatica with disturbance of the fluid mechanism."

ALPERS, Philadelphia.

STUDIES ON THE THYROID APPARATUS: XXXI. THE RÔLE OF THE THYROID AND PARATHYROID GLANDS IN THE GROWTH OF THE CENTRAL NERVOUS SYSTEM: XXXII. THE RÔLE OF THE THYROID APPARATUS IN THE SOLIDS—WATER DIFFERENTIATION OF THE CENTRAL NERVOUS SYSTEM DURING GROWTH. F. S. HAMMETT, *J. Comp. Neurol.* **41**:171 (Aug.) 1926.

Both of these papers involve data concerning the same group of animals. Further contributions to the extensive studies that Hammett has previously published on the thyroid apparatus in the rat are found here in the records of weight changes of the brain and spinal cord of groups of albino rats subsequent to removal of the thyroid and parathyroid at six different ages ranging from 23 to 100 days (between weening and maturity).

In general, the growth of the central nervous system is retarded after the removal of either gland at any age. This degree of retardation is less than that of the body as a whole. In other words it has more resistance to glandular deficiency than the body as a whole. This is considered to be the result of the difference in chemical make-up and in degree of response to the general lowering of the metabolic level. The degree of retardation of the central nervous system tends to increase with increase in the age of the animal at the time of thyroid removal, while in parathyroidectomized animals the degree of retardation is remarkably constant, not increasing with age. This difference from removal of the thyroid is taken by Hammett as a specific relation between the parathyroid and central nervous system and is traced to a toxemia that follows removal of the parathyroid.

At the age of puberty (65 days in the male and 75 in the female) a distinct and significant adjustment in the growth response of the central nervous system to both types of glandular deficiency takes place. There is less retardation of growth before puberty and more retardation after puberty. The brain is more subject to this gonadal influence than is the spinal cord, and the male shows a greater response (increased retardation of growth) at the onset of puberty than the female. It is suggested that there may be a definite interrelation between gonadal activity and brain growth, which is unmasked by removal of the thyroid and parathyroid at the critical point.

The fact that up to the establishment of puberty growth of the cord is not any more resistant to thyroid deficiency than growth of the brain, leads the author to discard his earlier hypothesis (*J. Comp. Neurol.* **37**:15 [June] 1924) dealing only with the 75 day age, that the greater resistance of growth of the cord to removal of the thyroid is the result of differences in phylogenetic development of the cord, brain and thyroid gland. This fact also necessitates a modification of the interpretation that he made in an earlier paper (*J. Comp. Neurol.* **35**:313 [June] 1923), based on differences in chemical composition.

The studies in the second paper (XXXII), dealing with the central nervous systems in the same animal, are concerned with the amounts of weight changes in solids and water after the removal of the thyroid and parathyroid glands as compared with normals. Normally, the percentage of solids, which is always by percentage increment greater than water, increases with age, while the percentage of water decreases. As in all growth percentage increment decreases with age.

Thyroid and parathyroid deficiencies likewise cause a greater retardation of increment in water than in solids in the central nervous system. Only at puberty are sex disturbances of water-solid differentiation significant. Increased retardation is greater in the brain than in the spinal cord and greater in the brain of the male than in the female, which correlates again with the observations noted in the first paper (XXXI). The distortion is greater in thyroid than in the parathyroid deficiency and is attributed to a lesser degree of nutritional disturbance in the parathyroidless group. In the cord in which lipoid (myelin) constituents are greater than in the brain and in which protein (cell substances) is greater in amount, the greater resistance to metabolic disturbance is taken as a basis of the difference in distortion, the lipoid being more resistant to glandular deficiency.

STONE, New Haven, Conn.

THE PROBLEMS PRESENTED BY GENERAL PARESIS. EMIL KRAEPELIN, J. Nerv. & Ment. Dis. 63:209 (March) 1926.

Neurologists are still in the dark as to the essential nature of general paralysis, particularly regarding the development and the specific reactions that attend it. The boundary between mesodermal and ectodermal tissues of the brain has been erroneously supposed to distinguish the infections of cerebrospinal syphilis from general paralysis. It is true that the cellular sheaths of perivascular lymphoid tissue are more massive in cerebral syphilis than in general paralysis and are confined largely to the meninges; in the latter case the diffuseness of the lesions suggests that the germs circulate with the blood. Some change obviously takes place in the organism, rendering it possible for *Treponema* to become lodged in the brain. The course of general paralysis, with its picture of progressive decay, favors the assumption that the entire organism is involved. In general paralysis this fatal decay is associated with severe metabolic disorders, unlike the other syphilitic or arteriosclerotic disorders of the brain. The late development of general paralysis after infection has taken place contrasts it with cerebrospinal syphilis which may become manifest after a few months only, and this fact justifies the belief in some specific preparatory process. In some cases the disease may progress so slowly that only a single prodromal symptom may be present at first. As only 4 or 5 per cent of syphilitic patients suffer later from general paralysis, obviously some special conditions must be fulfilled. Nothing has as yet confirmed the belief in a special type of *Treponema*, although it is true that syphilitic nervous disorders rarely accompany severe syphilitic skin infections. Plaut and Mulzer, however, have shown that certain strains of *Treponema* have a greater disposition to cause a pleocytosis in the rabbit than others. It is far more sure that individual disposition is a significant factor in causation. The condition develops far oftener in men than in women and seldom in children. It appears that the youthful organism is better protected against the paralytic process. Locality also has some significance instanced by the rarer incidence of the disease in Iceland, Scandinavia, Spain, India and Africa. Moreover, the rare description of the disease in past centuries and the fact that the first indisputable cases were described at the end of the fifteenth century suggest that during the last century some changes have taken place in the physical conditions of nations. Forty or fifty years ago the disease was rare among the North American negroes, whereas at present its incidence equals that of the white man. Civilized man seems more susceptible. The study of the histories of a number of paralytic patients does not suggest, however, that the nervous strain and excitement of modern civilized life has any appreciable significance.

The war was excitement enough, yet there was no immediate rise in the incidence of the disease. Of course alcohol addiction predisposes to the contraction of syphilis, and the races such as the Mohammedans and Bosnians that are abstemious are infected more rarely than the Catholic Croats of the same region, who are often affected. Pilcz and Mattauschek have shown that men who suffered from infectious disease subsequent to the infection with syphilis later did not suffer from general paralysis, and this coincides with the fact that races free from general paralysis regularly are much more exposed to all kinds of infections than the European. The presence or absence of early antisyphilitic treatment seems to be of no outstanding significance, and a history of a psychosis in the family carries little bearing. It is probable that the metabolic insufficiency of the general paralytic person is responsible for the irreparable decay and for the failure of antisyphilitic medication. Hence, the metabolism of the general paralytic patient should be under constant study. One needs comparative statistics of incidence in different countries, sexes and ages as well as the corresponding incidence of syphilis itself gained by means of the Wassermann reaction. Alcoholism and infectious diseases should be studied in relation to general paralysis as well as the efficacy of antisyphilitic treatment.

HART, Philadelphia.

PSEUDOBULBAR PALSY. AKIRA KAWATA, Arb. a. d. neurol. Inst. a. d. Wien. Univ. 28:143 (May) 1926.

After reviewing the literature, Kawata reports in detail the clinical and pathologic features in six cases of this syndrome. All showed evidences of marked cerebral arteriosclerosis. The anatomic picture was remarkably uniform, the variations in the different cases being quantitative rather than qualitative. Ascending from the pons usually was found a sclerosis, gradually increasing to calcification of the medium sized and even of the smaller vessels. In addition to this there was a typical perivascular disintegration leading in some cases to a status spongiosus. In other cases the process was more in the nature of a softening with cyst formation; in these, the cysts in the cortex were replaced by areas of dense glial proliferation—a dehiscent sclerosis.

The areas of disintegration seem to have certain sites of predilection; the first site is the basal ganglia with the striatum as the most common locus; they are less frequent in the thalamus, and still less frequent in the mesencephalon, whereas the changes in the blood vessels themselves are more prominent in the pons and in the cortex. It was also noteworthy that the hemorrhages that were invariably present were slight in extent. One case also showed evidences of an inflammatory process similar to that described by Bernis.

It must be emphasized that this form of severe arteriosclerosis did not affect aged patients; the woman in whom the vessels showed the most marked sclerosis had not yet reached her fortieth year, and although syphilis was suspected its presence could not be demonstrated anatomically. The oldest patient in the group was 63. In this connection it is well to recall that Oseki, who had examined the basal ganglia in aged patients also found marked sclerosis in the vessels but no disintegration, cyst formation, or status spongiosus.

Kawata divides the arteriosclerotic cases into two groups, the benign and the malignant. The malignant character may possibly be the result of the rapidity of development of the arteriosclerosis, because with a gradual and slower development of the process, the tissues have greater opportunity to adapt themselves to trophic changes than with a more rapidly developing sclerosis.

The clinical differentiation between the arteriosclerotic pseudobulbar palsies and the pseudobulbar palsies due to other causes is easy only in the cases with history of an apoplectic onset followed by a rapid progression of symptoms. Great difficulties are encountered in cases in which, owing to a defect in intelligence, a previous history of an apoplectic insult cannot be obtained, and in those cases in which such an insult had never occurred and the patient presents symptoms that can readily be interpreted as manifestations of increasing cerebral pressure. Fortunately, all of the author's patients presented evidences of severe involvement of the heart and aorta; this was of considerable assistance in determining the nature of the cerebral process.

The great variations in the clinical picture in the different cases, in the presence of similar or almost similar localizations of the pathologic process, were striking. Any attempt to reconcile the clinical picture with the pathologic observations and to construct a "disease concept" is, in the present state of knowledge, impossible; the author therefore suggests that pseudobulbar paralysis be regarded merely as a "symptom complex."

KESCHNER, New York.

ON BRAINS WITH TOTAL AND PARTIAL LACK OF THE CORPUS CALLOSUM AND ON THE NATURE OF THE LONGITUDINAL CALLOSAL BUNDLE. CORNELIA DE LANGE, *J. Nerv. & Ment. Dis.* 62:449 (Nov.) 1925.

The author reports the case of a boy born in asphyxia who had shown strange slow movements, cried in a curious, harsh voice and presented a narrow retreating forehead with sunken temporal fossae, with hands pronated, moving continually and with a generally hypertonic musculature. He showed nystagmus, and the eyes had a peculiar stare. Nothing else was observed clinically. The child died of pneumonia in the fifth month. Slight anomalies in the thymus, pituitary, and thyroid glands are mentioned. The striking feature was extensive polygyria and the absence of the corpus callosum. Olfactory nerves and bulbs were not found. There was no macroscopic difference in size between the two hemispheres. The left fornix was less easily traced than the right. Examination of the cortex showed polygyria to be especially marked over the frontal lobes of both hemispheres, in the gyrus centralis posterior, supramarginalis, and angularis, with extra convolutions in the gyrus cinguli. The calcarine fissure was distinguished with difficulty and did not meet the parieto-occipitalis as it should normally. The fornices were separate over their entire course, and the septum pellucidum was lacking except for the pre-commissural part. There was no epiphysis. Microscopic examination of the cortex showed no trace of inflammation. The internal granular layer was larger than normal and everywhere present and in the polygyric areas minor development of layers V and VI showed the inhibition of cortical development. A review of the literature showed only seventy-one cases, forty-three of which showed total or almost total absence of the corpus callosum. Various opinions have been expressed as to the nature and course of the callosal bundle, which the author regards as part of an associative system between frontal and occipital, and between parietal and frontal lobes. She is convinced that the greater part of the tapetum belongs normally to the corpus callosum, and that when the latter is absent it contributes to the formation of this longitudinal bundle. The study of another brain with a thin frontal corpus callosal crossing and a broader noncrossing part with the formation of a pseudosplenium convinced the author that the fibers in the pseudosplenium run in exactly the same way as they do in brains without a corpus callosum. Hence, it is con-

cluded that the longitudinal callosal bundle represents the noncrossing callosal fibers. Only one case (Bianchi) was not associated with other anomalies. Juvenile general paralysis and internal hydrocephalus have been reported as etiologic factors, the latter by pressure being supposed to increase the distance between the hemispheres and preventing the crossing. In the author's case, evidence of ependymitis but not much evidence of hydrocephalus was found. That the corpus callosum is concerned with higher functions is evidenced by the mediocre intellectual status of the patients who varied from individuals incapable of producing intelligible sounds to practically normal ones. In cases of agenesis of the corpus callosum muscles of both halves of the body are coordinated, presumably because one hemisphere has taken over all the finer regulation of spontaneous, associative movements, the other remaining totally inactive. Most of the cases reported in the literature showed a difference in size between the right and the left hemisphere, generally in favor of the former.

HART, Philadelphia.

EXPERIMENTAL INVESTIGATION OF PERIPHERAL NERVE CHANGES IN LEPROSY. Y. TAKEUCHI, Arb. a. d. neurol. Inst. a. d. Wien. Univ. **28**:135 (May) 1926.

The author had previously shown that in leprosy of the peripheral nerves the pathologic process is not only limited to the perineurium but also affects ectodermal elements. Most of his cases showed marked thickening of Schwann's sheaths as well as swollen axis cylinders in the nodular thickenings of the nerves. The lepra bacillus could also be demonstrated in the nerves. The fact that in Japan leprosy also occurs in rats, and as the course of the disease as well as its biologic and morphologic features is the same in these animals as in man, led Takeuchi to investigate the nerves in rats with leprosy.

The experimental production of leprosy in rats had already occupied the attention of numerous investigators. Marchoux did not have any difficulty in producing the disease in the ordinary domestic rat, the white rat, and in mice. Yasugi, on the other hand, made twenty-three attempts to inoculate domestic rats with human lepra bacilli, and came to the conclusion that leprosy in man differs from leprosy in rats. This conclusion was also confirmed by Uchida. As lepra emulsions from man did not produce any manifestations of the disease in rats, Takeuchi prepared such emulsions from house rats; other rats after being inoculated with the emulsions, developed leprosy; the nerves from these were then subjected to careful study.

As a result of this investigation, Takeuchi is convinced that leprosy also produces changes in the nerves in rats. No comparison could be made with the pathologic process in the nerves of man because in the latter only the cutaneous nerves were subjected to microscopic study, and the lesions were predominately chronic. Several facts, however, could be definitely established. The process in rats is by no means acute; it is more or less chronic. All blood vessels in the affected areas show actual changes—thickening of the walls of the arteries as well as of the veins, although it is questionable whether a formation of new vessels occurs. As far as Schwann's sheath is concerned, one can hardly speak of a thickening of this structure; in most of the cases, the nuclei are not even increased. On the other hand, all animals show involvement of the nerve parenchyma, axis cylinders as well as myelin sheaths being affected; here and there one finds an axis cylinder completely torn across with a small balloon-like swelling of the ends. In the myelin sheaths, one can readily make out the septums between some of which the myelin remains intact, whereas between

others it is partly disintegrated. Some of the sections showed lepra bacilli as well as lepra nodules. It is noteworthy that in rats, just as in man, the bacilli are found not only outside but also within the myelin sheath. Finally, as a coincidental observation, in almost all animals there are peculiar oval structures of considerable size—apparently cells with a light vesicular nucleus and membrane; these are found in the perineurium as well as in the endoneurium between the nerve fibers; stained with methylene blue, they show definite granulations, which appear to be plasma cells or coccidia.

The only difference between nerve leprosy in rats and that in man is that the process in the latter is more acute, but even this difference may be due only to the fact that central and not cutaneous nerves were examined.

KESCHNER, New York.

NISSL GRANULES OF PRIMARY AFFERENT NEURONS. SAM L. CLARK, J. Comp. Neurol. **41**:423 (Aug.) 1926.

An attempt is made to correlate the Nissl granule pattern of primary afferent neurons with that of function. Studies are recorded of cranial ganglia, spinal ganglia, a few sympathetic ganglia and the mesencephalic nucleus. The material was taken largely from dogs and supplemented by portions of the mesencephalon from beef as well as ganglia from cats. All the material was fixed in 95 per cent alcohol plus 5 per cent acetic acid within an hour after the death of the animal. Sections were stained in toluidin blue. A description is given, supplemented by drawings, of the various cell types identified, and a table summarizes the percentages in which these types occur in different ganglia. A classification, modified from those of other investigators, presents seven definite cell types which can be identified in constant proportions in various ganglia. It was not always possible to detect the type of every cell, for some cells have characteristics common to two or more types. It is suggested that cells of any type may be altered in appearance during functional activity.

The cochlear ganglion consists entirely of small cells of a single type, distinctly different from any other primary afferent neuron here considered. The vestibular ganglion, on the other hand, is almost entirely made up of cells a little larger but the Nissl granules of which are like those of the superior cervical sympathetic cells. This fact plus the fact that both the cochlear and vestibular ganglion cells have Nissl granules the same size as those of the efferent type shows that something besides special function is responsible for the Nissl granule arrangement. In cranial nerve ganglia a special arrangement of Nissl granules occurs in the visceral afferent neurons, but apparently the same type of cell exists for both general and special visceral fibers. This group is not sharply defined in the spinal ganglia. Froriep's ganglion, which is found on the small "dorsal roots" of the hypoglossal nerve, shows, in differential counts of the cells, the same types of cells in about the same proportions as in spinal ganglia, and it is suggested that it is an aberrant spinal ganglion. The neurons of the mesencephalic nucleus of the trigeminal nerve also resemble spinal ganglion cells and not motor cells. Although primary afferent neurons of other function have apparently the same structure, it seems probable that the fibers arising from these cells in the mesencephalic nucleus mediate muscle-sense impulses through the nerves to the muscle to which they run. This is supported by the fact that electric stimulation of these fibers does not produce any visible effect on the muscles in question.

The variations and overlapping of the Nissl granule patterns which Clark has clearly brought out cannot fail to impress the reader of the great importance

in work of this sort of checking with controls the changes that may take place in various fixing reagents at various times after the death of the cell and subsequent treatment of the sections in preparation for study. To be sure, it would be a task of great magnitude, but at the present time there are not any published data that would give a comprehensive view of how important these factors may be in interpreting cytologic patterns of this kind.

STONE, New Haven, Conn.

DECEREBRATE RIGIDITY OF THE SLOTH. CURT P. RICHTER and LEO HENRY BARTEMEIER, *Brain* 49:207 (June) 1926.

As all previous decerebration experiments had been performed on quadrupeds with resultant extensor rigidity maintaining the animal in standing position, its normal posture, this work was undertaken to ascertain whether the same principal would apply to an animal like the sloth, whose normal posture is hanging with flexion of the limbs. Sixteen animals were decerebrated at levels below or above the red nucleus by the technic of Bazett and Penfield.

In the sloth, decerebration produces flexor rigidity of the limbs and trunk and "reflex hanging" instead of extensor rigidity and "reflex standing" as in the decerebrate cat. The posture of the decerebrate sloth varies with the level of transection. With the red nuclei removed, the posture closely resembles the animal's resting posture in that the rigidity is marked in the trunk and limbs but less so in the claws; therefore it cannot hang well. When the cut is made above the red nuclei, the rigidity of the limbs and trunk is less marked, but it is more marked in the claws, so that the animals are much better able to maintain their normal hanging posture; one animal remained hanging for thirty hours after this operation. This work is in accord with that of Magnus and Rademaker, who found that cats decerebrated below the red nuclei showed marked rigidity of the limbs and trunk; in the animals in which the red nuclei were left intact there was less rigidity but a normal distribution of tone and a normal standing posture. The authors think that many results in regard to the standing reflex have been confusing owing to the fact that in the animals with low decerebration some authors have failed to distinguish between the strong rigidity present and the ability to maintain the normal standing posture. The most important effects of decerebration appear in the different parts in the order of their importance for the maintenance of normal posture—the hind legs in the sloth as compared to the fore legs in the cat.

Similarities in the physiologic characteristics of flexor and extensor rigidity are discussed. They show in common the lengthening and shortening responses, reflex inhibition from phasic reflexes and lack of fatigue. It is pointed out that the posture of the decerebrate sloth cannot be explained by stating that the antigravity muscles are involved; it is necessary to refer also to the habitual posture of the animal. On the basis of present knowledge regarding decerebrate rigidity, derived on the one hand from animals that use their extremities in standing, and on the other from those that use them for hanging or holding, the authors apply this principle to man. They state that since in normal man the legs are extended in supporting the body, and the arms and hands flexed in lifting and holding, decerebrate man probably would show extension of the legs and flexion of the arms and fingers. They cite a clinical case of hemiplegia which showed all of the criteria of true experimental decerebrate rigidity, Magnus-de Kleijn reflexes, lengthening and shortening responses, and reflex inhibition due to phasic reflexes. In addition, it showed extensor rigidity of the leg and flexor rigidity of the arm, which confirmed Walshe's conclusions reached from a somewhat different angle.

STACK, Milwaukee.

PUBLIC AND PRIVATE PROVISION FOR THE EPILEPTIC. L. PIERCE CLARK, Ment. Hyg. 10:787 (Oct.) 1926.

An outline of development in the care of epileptic patients is presented, with a description of some of the principal factors that led to the establishment of the colony plan. Formerly, the epileptic patient was recognized merely as a social misfit who had to be removed from the community. As he was generally asocial and if his economic status was low, he usually drifted into an almshouse or a state hospital. In the former instance he frequently deteriorated, as environmental treatment was not provided. In the state hospital he was frequently placed with the feeble-minded or the insane. Until recently, epileptic patients were not classified and were treated mainly with a view toward management during the epoch of seizure. It is now understood that the disturbances of personality appear before the period of seizures and that the whole disorder is a manifestation of the psychobiologic reaction type, so that individual care is required in each case. Generally, epileptic patients stand restraint poorly, show marked egoistic strivings which, on deeper levels, may be interpreted as sadistic with tendencies toward suspiciousness. Despite some of these antisocial characteristics, epileptic patients frequently show a strong sense of justice, and are not lacking in courage.

The modern trend is toward regulation of the environment so that sufficient freedom may be permitted, with outlets in the form of various activities; provision also is made for reeducation, habit training, and assistance in gaining self knowledge.

Through religious and private benevolent organizations, Germany, France, and Switzerland have made provisions for special institutions for epileptic patients. Germany is farthest advanced in this respect, with fifty hospitals containing special facilities for the care of these patients, including a large colony near Bielefeld where 3,000 acres have been set aside with equipment in such industries as farming, fruit growing, printing, book-binding, cabinet work, etc. A small remuneration is afforded, and trade schools are maintained in the colony.

In this country, the state of Ohio was the first to erect special buildings for epileptic persons (1891). Since then several states have made some provisions for these patients, although many still keep them with the insane. Craig Colony, in New York, was established in 1896. Cottages were built to house a school, chapel, workshops in trades and industries, and club rooms with recreational facilities. The author describes the general plan of this institution.

It is generally held that epileptic persons progress better in small groups and, rather than attempt to make them good mixers, effort should be directed at objectivating their own interests. These principles are employed also in caring for more well-to-do or semi-independent patients. Carefully supervising the milieu, arranging for small units involving the pattern of family life, and permitting sufficient liberty to work out individual needs are the main environmental requirements. Each patient must be studied as an individual.

EISLER, Chicago.

THE PATHOGENESIS OF TABES DORSALIS. HANS SPITZER, Arb. a. d. neurol. Inst. a. d. Wien. Univ. 28:227 (May) 1926.

Redlich's investigations in this field were the author's basis and guide for this study. The material at Spitzer's disposal consisted of five cases of cerebrospinal syphilis, three of taboparesis, fifteen of pure tabes and one case of tuber-

culosis of the cord. Sixty-nine spinal roots with their ganglia were examined in serial sections. The sections of the spinal cord were studied in myelin, cell and glia preparations; in several cases sections of the cerebral cortex, of the walls of the ventricles and of the first and second cranial nerves were studied. More than 5,000 sections were examined.

As a result of this investigation, Spitzer is convinced that tabes begins in the so-called Redlich-Oberstein area (point of entrance of the posterior roots into the cord). The spinal ganglia were found relatively intact. The tabetiform granulations begin in the coverings of the nerve roots in which Richter demonstrated the presence of spirochetes; varying numbers of these granulations invade the spaces of the root coverings and in some instances the nerves themselves. The motor nerves also seem to participate in the process. The toxins arising directly or indirectly from the spirochetes enter the subarachnoid space through the cerebrospinal fluid and affect the posterior roots at the point of least resistance; these now undergo secondary degeneration in the central direction. After the Redlich-Oberstein areas have been affected by the toxic effects of the cerebrospinal fluid, the ganglionic part of the root is also subjected to the same deleterious influences. All parts exposed to the cerebrospinal fluid show manifest changes. The meninges subjected to toxic irritation react in the tabetic process almost invariably with a meningitis. A reactive glial proliferation is also observed in the walls of the ventricles. The variations in the histologic picture are the result of variations in the localization of the spirochetes. The spirochetes in the meninges exert their toxic effects on the subpial space and give rise to the so-called marginal syphilitic sclerosis. An analogous process in the coverings of the optic nerve produces optic atrophy.

"Metasyphilis" is a toxibacterial infection of the subarachnoid space. A preponderance of the bacterial local components of the process gives rise to general paralytic phenomena, whereas a preponderance of toxic diffuse components of the process gives rise to tabetic phenomena. This schematic formulation is only valuable anatomically and suffices for the understanding of the topography of the process. It is not of any value serologically, because there is no precise periodic variation of the process; the general paralytic process usually follows the tabetic process; it is questionable whether the reverse of this ever occurs. It remains for the future to solve the serologic problem of metasyphilis. If histology should succeed in finding the equivalents of the serologic phases, it would aid greatly in supplying this deficiency in our knowledge.

KESCHNER, New York.

ABSCESS OF THE SPINAL CORD: REPORT OF A CASE WITH FUNCTIONAL RECOVERY AFTER OPERATION. HENRY W. WOLTMANN and ALFRED W. ADSON, *Brain* 49:193 (June) 1926.

A girl, aged 11, in June, 1921, suddenly had chills and fever; the next day the legs were paralyzed and urination was impaired, but disturbance was not noticed in sensation. At the end of three months she could walk fairly well and soon entirely recovered. In May, 1923, the legs again gradually became weak and by September she was unable to walk; there was never any pain. Examination revealed a spastic paralysis, increased patellar and Achilles reflexes, and bilateral extensor plantar responses. Vibratory and postural sensibilities were absent in the legs; touch, pain, and temperature sensibilities were greatly impaired over the lower limbs and the peri-anal area up to the level of the eighth dorsal segment; control of the sphincters was considerably impaired. The spinal fluid was yellow, under low pressure and showed increased globulin. A diagnosis

of meningomyelitis with spinal block was made, and an operation was performed. A greatly thickened dura was found, and incision along the posterior aspect of the cord allowed the pus from an encapsulated abscess to escape; the pus was verified microscopically. In two weeks there was return of movement and sensation, and two months later the patient walked without crutches. There was a slight relapse soon afterward with some impairment of sensation, but when seen again in September, 1925, the patient walked normally except for slight ataxia; sensation, reflexes and sphincter control were normal.

This is a remarkable case; of the twenty-nine cases of abscess of the cord reported in the literature, all but one were fatal. In the cases reviewed there was no particular age of incidence; as causes, diseases of the spine and lungs and bronchiectasis were the most common. The low incidence of abscess of the cord is attributed by most writers to: (1) the relatively small mass of the cord; (2) the small lumen and indirect course of the vessels entering the cord; (3) the protected location of the cord compared to that of the brain; (4) the presence of a protective agent, probably chemical (Schlesinger). The duration of the disease is from three days to seven months. In twenty-two cases the involvement of the cord was diffuse; there were multiple abscesses in three; abscess in the brain was associated in four. Meningitis was associated in at least fifteen cases. Owing to the diffuse involvement and the fulminant course flaccid paralysis was observed in at least one half of the cases.

The authors state that abscess of the cord is almost impossible to diagnose, and that meningomyelitis is the most usual conclusion reached. Since the lesions are usually diffuse, the cases are nearly all fatal; but the authors think that occasional patients with abscess of the cord may be saved by exploratory laminectomy and incision of the cord.

STACK, Milwaukee.

ENCEPHALITIS ACUTISSIMA. JOHANN L. ECKEL, *Jahrb. f. Psychiat. u. Neurol.* 45:7, 1926.

A previously healthy man, aged 50, suddenly developed deep coma in which he died within two hours, without other objective evidences of involvement of any of the systems. Necropsy revealed diffusely scattered, small subpial hemorrhages covering the surface of the brain; the hemorrhagic areas showed a striking brownish discoloration; on cross section the brain was found studded with innumerable dark brown patches varying in size from the head of a pin to a lentil; these seemed to have invaded the entire central nervous system. The pathologist diagnosed the condition as cerebral purpura, but owing to the brownish discoloration of the patches he transmitted the brain to the laboratory for microscopic examination. The latter showed that most of the patches consisted of extensive perivascular infiltrations containing polymorphonuclear leukocytes. The uppermost part of the cortex also showed an extensive glial reaction; there was considerable cerebral edema with changes in the ganglion cells, which were surrounded by many polymorphonuclear leukocytes. The vessel walls showed swollen endothelial cells and polymorphonuclear leukocytes in the adventitia. In the deeper parts of the brain there was to be seen a similar process, to which various sized hemorrhages and perivascular edema with destruction of many of the nerve fibers were superadded. The changes in the nerve fibers were similar to those observed in "spongy degeneration," and were much more marked in the gray than in the white substance. The inflammatory process was more intense in the brain stem, and reached its maximum in the pons.

The histologic picture was that usually encountered in secondary septic purulent affections; no such etiologic factor, however, could be found in this case. Many of the leukocytes in the infiltrates showed evidences of beginning regressive changes, indicating that the "crisis" of the disease apparently had been passed. Eckel believes the condition to be analogous to that usually observed in acute poliomyelitis, in which the presence of leukocytes cannot be demonstrated twenty-four hours after the onset of the illness. The clinical course and histologic picture of the case would seem to point to a most acute form of encephalitis; whether this was due to a micro-organism or to a toxin, Eckel could not determine; he is therefore unable to classify this particular type of acute, nonpurulent encephalitis. The case is interesting also from a medicolegal point of view as coming within the category of "sudden death."

KESCHNER, New York.

THE CEREBELLUM OF REPTILES: LIZARDS AND SNAKE. O. LARSELL, J. Comp. Neurol. **41**:59 (Aug.) 1926.

Larsell's previous publications have dealt with the cerebellum of amphibia. The present study has the comparative point of view primarily in mind and is extremely valuable in the comparative studies of the cerebellum of vertebrates. The median portion of the cerebellum of the reptiles here described varies a great deal, and this region is called the pars interposita. The lateral portions are called the pars lateralis (primitive corpus cerebelli). He points out an exceedingly interesting correlation between the final development of parts of the cerebellum and that of the mode of locomotion and degree of activity in these species. It is noted that in the snake the pars interposita makes up the major part of the organ. It also is large and well developed in a lizard, e. g., *Gerrhonotus*, in which the use of trunk and tail muscles likewise play a large rôle in locomotion, while the pars lateralis is not well developed.

On the other hand, in a lizard like *Sceloporus*, an exceedingly quick, darting, active animal, whose limbs are the important factors of locomotion and the trunk and tail muscles unimportant, the pars lateralis is large and the pars interposita is small. This latter type of cerebellum, although it seems more simple and approaches the primitive amphibian cerebellum, is not considered primitive but as an example of extreme specialization of this type of simple cerebellum. In other words, the lack of development of the pars lateralis is accompanied by degeneration of the extremities, and overdevelopment of the pars interposita is coexistent with development of special locomotion characteristic of serpents. A rudiment of the auricular lobe or flocculus is present in the snake and lizards, and fiber connections here as well as in general are similar to those of mammals. Deep cerebellar nuclei are present as medial and lateral masses in reptiles, as compared with a single mass described by Larsell in amphibians.

STONE, New Haven, Conn.

INVESTIGATIONS OF THE METABOLISM IN MANIC AND DEPRESSIVE STATES: II. CHANGES IN THE CALCIUM AND POTASSIUM CONTENT OF THE WHOLE BLOOD. EDITH KLEMPERER, Jahrb. f. Psychiat. u. Neurol. **45**:32, 1926.

(1) In simple melancholia, the calcium content was diminished and the potassium content varied between normal and the highest limits. In melancholia agitata, the calcium content exceeded the normal, whereas the potassium content did not show any uniform change. In melancholia with stupor there was a marked diminution in the calcium content which fell still lower when

there was an aggravation of the symptoms, but the potassium content was markedly increased. (2) In the manias, the calcium was increased and the potassium diminished. In one patient there were periods during which both of these symptoms occurred, while there were other periods during which only one of them occurred. The reason for this variability could not be found in the patient's condition. Mild cases did not show any changes in the ion concentrations. (3) In manic schizophrenic cases, both diminished as well as normal calcium figures and normal potassium figures were found. It had been assumed previously that in these cases the calcium normal was low. (4) In cases of catatonic stupor with marked muscular rigidity the calcium content was increased; this may perhaps have been caused by circulatory disturbances. (5) It has been claimed that manic-depressive states are physiologically associated with rhythmic changes in the ion concentration of the organism. Such changes may occur to a high degree in some persons, or they may be physiologic in persons apparently endowed with poor resistance. (6) In a case of recurring catatonia there was a diminution in the calcium content and an increase in the potassium content during stupor; with the onset of manic symptoms the calcium rose to normal, but did not exceed normal when the patient became markedly excited, and became subnormal as soon as she became quiet; the potassium fell to normal.

KESCHNER, New York.

1926 EMPHASES IN PSYCHIATRIC SOCIAL CASE-WORK. A. M. LEAHY, *Ment. Hyg.* 10:743 (Oct.) 1926.

The principal emphases in psychiatric social work during 1926 may be summed up under three headings. In group 1 are the problems concerning the social worker herself. These seem to involve mainly unrecognized influences arising from her emotional attitude in which various prejudices condition her methods in case work. These may be of a social, religious, sexual or racial character, and frequently include mechanisms of identification, which cause her to overemphasize certain aspects of the whole situation, and to ignore other useful phases of the problem. The author believes that some form of psychiatric examination or emotional testing of the social worker should be considered in order to eliminate some of these difficulties. It is being generally recognized that, in addition to a background of full life experience, adequate training in psychiatric social case work is necessary. At present these professional standards are growing progressively higher.

In group 2 are questions relating to social treatment. There is an apparent need of a better evaluation of the plans determined on, with more follow-up work. The agencies that are generally used to assist the patient, such as dispensaries, schools, settlement houses, summer camps, etc., are merely means to an end—that of helping the patient to a better adjustment. Special care is required in dealing with the nuances of the whole situation with the realization of the need for knowledge of human tendencies and attitudes while working with relatives, teachers and others.

In group 3 are problems of the record. The value of both topical and chronologic forms is outlined with the suggestion that statistical face sheets might be used after a first contact is made. To assist in accumulating useful data for research, the record of treatment should convey a better representation of the manner and technic with which recommendations were carried out.

EISLER, Chicago.

PERSONALITY CHANGES AND UPHEAVALS ARISING OUT OF SENSE OF PERSONAL FAILURE. A. T. BOISEN, *Am. J. Psychiat.* **5**:531 (April) 1926.

The author, research associate in the social ethics department of the Chicago Theological Seminary, presents a chart based on thirty-nine cases of mental disorder studied at the Boston Psychopathic and Worcester State Hospitals, thirty-six cases of religious experience obtained in a survey of churches and missions of Roxbury, Mass., and an analysis of the experience of five men of outstanding religious life. The primary "evil" in the abnormal subjects seemed to be a sense of personal failure. Controlling desires were either integrative, (a) the will-to-serve or (b) the will-to-power, or they were segmental and regressive—with various conflicting desires ranging between these extremes. The subject's degree of awareness of his own difficulties varied from clear to complete obliviousness. Reaction modes ranged from honest facing of the situation through concealment, compromise, "bluffing," shifting of responsibility on other persons, things or physical ailments, and emotional explosions to complete withdrawal or surrender. The character change was gradual, without marked upheaval, or abrupt with narrowing of attention, mood changes, dissociation, regression, ideas of death and world destruction, confusion and stupor. The subject's attitude varied from one of reverence and faith in religious types and self-reliance in the "normal" man's adjustment, through the flippancy and carelessness of the criminal who has lowered his standards, the cynicism and faultfinding of the misanthrope who maintains self respect by belittling others, through the intolerance of the ascetic, prude and legalist who bolster up their self respect by making much of minor virtues, the suspicion and jealousy of paranoid persons, the self importance of cranks and eccentrics, the anxiety and self pity of psychoneurotic persons, to pronounced schizophrenic behavior. The tabulation is interesting as an attempt to present *multum in parvo*, and also as the effort of a lay religious worker to study religious experience along with other types of life reaction.

READ, Chicago.

INTRACRANIAL ANEURYSMS. REPORT OF A CASE. IRVING J. SANDS, *J. Nerv. & Ment. Dis.* **64**:12 (July) 1926.

Recognition of intracranial aneurysms still remains difficult. Gull gives several reasons why they are likely to be overlooked. Recent coagula may so embed and conceal the sac that unless it is looked for it will not be found. In some cases changes from pressure or softening may make the discovery of the sac impossible without minute dissection. Gull regarded death in young persons with symptoms of *ingravescent apoplexy* as probably due to aneurysm. Beadles made an exhaustive study of 555 cases and concluded that it was impossible to diagnose an aneurysm of any of the cerebral arteries except in most unusual circumstances. He stressed the intermittent character of the symptoms and found that a correct diagnosis could not always be made from the side on which the signs were most prominent. Vertigo and headache were inconstant. Deafness was occasionally a leading symptom. The further the aneurysm from the cranial nerves the rarer the symptoms. Fearnside, in a study of forty-four cases, divided them into noninflammatory, due to congenital weakness of the wall at the junction points, and those due to infective emboli with ulcerative endocarditis. Symonds divides the symptoms into three divisions: (1) those due to mechanical pressure on surrounding structures, such as cranial nerves, etc.; (2) those due to the primary infective cause of aneurysm

itself, e. g., arteriosclerosis, endocarditis; (3) those peculiar to the presence of the aneurysm itself, i. e., leakage of blood. The author presents a case of a woman, aged 23, similar to one described by Symonds. He emphasizes the presence of a bloody spinal fluid with cervical rigidity and a Kernig sign, together with cranial nerve lesions as suggestive diagnostic symptoms. The intermittent character of the symptoms is characteristic.

HART, Philadelphia.

A COMPARISON OF THE IRRITABILITY OF MEN AND WOMEN. E. WILLIAMS, *Am. J. Physiol.* **75**:52 (Dec.) 1925.

In the belief that knee reflex response may be taken as an index of general somatic tone and irritability, Williams investigated this reflex under carefully controlled conditions in a series of 133 apparently normal men and women. The results obtained revealed definite and consistent differences between the two sexes. Thus the average kick-height for the stimulus force employed (50 Gm.) was 19.48 mm. for the seventy women and only 13.71 mm. for the sixty-three men. In other words the average response for the women was 42 per cent higher than for the men. This contrast is especially vividly demonstrable if the total series is divided into groups on the basis of kick-height as shown in the accompanying table. Of interest also is the observation that in the case of only one woman a recordable jerk could not be elicited with the standard stimulus, whereas five failures were determined among the men. Williams concludes that if the knee reflex may be considered a valid criterion, women, on the basis of this work, must be regarded as more irritable in neural organization than men.

Comparison of Irritability of Men and Women on Basis of Kick-Height

Group	Kick-Height	Number of Men	Percentage of Men	Number of Women	Percentage of Women
A.....	0-9 mm.	32	50.79	25	35.72
B.....	10-29 mm.	23	36.51	29	41.43
C.....	30-69 mm.	8	12.70	16	22.85

RAPHAEL, Ann Arbor, Mich.

THE DISTRIBUTION AND PROBABLE SIGNIFICANCE OF UNMYELINATED NERVE FIBERS IN THE TRIGEMINAL NERVE OF THE CAT. W. F. WINDLE, *J. Comp. Neurol.* **41**:453 (Aug.) 1926.

It is estimated that small unmyelinated fibers, less than 5 microns in diameter, form between 20 and 30 per cent of the fibers in the trigeminal nerve and that all the unmyelinated fibers in the sensory root must be from 35 to 40 per cent of all the fibers in the nerve. Experimental removal of the superior cervical sympathetic ganglion did not cause any great material decrease in the percentage of unmyelinated fibers in branches of the trigeminal nerve except the nasociliary branch of the ophthalmic nerve. A table summarizes the comparative fiber counts in the peripheral branches of the trigeminal nerve. It is readily seen that nerves to the muscles of mastication are relatively free from unmyelinated fibers. However, there are a great many in the mylohyoid nerve, and it is suggested that this nerve may be partly cutaneous.

When compared to a spinal nerve, in which Ranson showed that unmyelinated fibers predominate, it is clear that the proportion of these fibers is distinctly not.

the same. The author, citing evidence from the literature to support his view, suggests that a more rapid rate of myelination generally has taken place progressively toward the cranial region, in which the cranial cutaneous nerves have reached a higher stage of development and are now partly myelinated. It is further suggested that painful afferent impulses in the trigeminal nerve are transmitted largely by small myelinated and unmyelinated fibers. This idea seems to be borne out in the nerve fibers to the cornea, which generally are conceded to be nerves mediating pain only and are composed largely of unmyelinated and small myelinated fibers.

STONE, New Haven, Conn.

THE EFFECT OF SUPRARENIN AND THYROXIN ON WATER ABSORPTION BY BRAIN TISSUE. J. A. HALDI and P. WRIGHT, *Am. J. Physiol.* **78:74** (Sept.) 1926.

In view of the known physicochemical effects of thyroid and suprarenal secretions on protoplasm in general, it was felt by the authors that it might prove of interest to investigate the effects of these agents on water absorption in certain higher tissues of the central nervous system. This phenomenon of water absorption by brain substance shows considerable variation in degree depending on the specific area examined. In the present work the cerebrum, midbrain, cerebellum, and medulla of rabbits were studied under carefully controlled conditions relative to the water absorptive effect of thyroxin and epinephrine solutions. Certain definite and consistent results were determined. Thus thyroxin seems to diminish the absorption of water in the midbrain and to increase it in the cerebellum but not to exert any demonstrable effect in this respect on either cerebrum or medulla. Epinephrine bitartrate, on the other hand, was found to diminish water absorption in all four of these tissues. In the case of oxidized solutions of epinephrine base, however, while the effect in the midbrain was the same as that determined for the bitartrate, the other tissues were found to be definitely stimulated in absorption capacity. Through this work further light is shed on the pathophysiology of certain aspects of swelling and edema of the brain, and the possibility of an effective endocrine relation, among other mechanisms, is at least raised. The authors themselves suggest from this point of view that there is possibly something to be said for a "colloid chemical basis of mental disorders." RAPHAEL, Ann Arbor, Mich.

EXPERIMENTS ON THE DEVELOPMENT OF THE EAR OF *AMBLYSTOMA PUNCTATUM*. HELEN WARTON KAN, *J. Exper. Zool.* **46:13** (Aug. 5) 1926.

Experiments on the embryos of *Amblystoma punctatum* showed that the ectoderm for a considerable region around the region of the normal ear is capable of regenerating an ear vesicle. A distinct loss of potency of regeneration occurs after invagination of the otic cup. The amount of regeneration also depends on the size of the piece removed. Regeneration is possible following extirpation of the ear region and the transplantation into this area of undifferentiated ectoderm from another embryo, but the amount of regeneration is lessened. The amount of regeneration depends on the same factors as in the case of simple extirpation. Complete development follows in about 25 per cent of the cases after removal of half the ear at the time of invagination. This is not true after closure of the vesicle. In 75 per cent of such cases, abnormal labyrinths result. The presence of undifferentiated ectoderm in the extirpated area does not check development following partial extirpation. Reciprocal transplants of one half of the ear region between white and pigmented embryos indicate that the endolymphatic

duct and macula sacculi develop from the dorsal half of the otic cup; the remainder of the vesicle comes from the ventral half; the anterior and lateral cristae and macula utriculi, from the anteroventral quadrant. The two halves of the auditory cup are capable of development independently into more or less complete labyrinths. The half that was transplanted into an abnormal location underwent much less development, in general, than the half that remained in its normal location. It is concluded that the ear at the otic cup stage represents a transitional stage between a condition of totipotence and one of equipotentiality.

WYMAN, Boston.

THE CLINICAL FEATURES OF SCORBUTIC NEURITIS. R. M. STEWART, *J. Neurol. & Psychopath.* 6:191 (Nov.) 1925.

Attention is called to the absence of any previous reference to sensory and reflex symptoms due to involvement of the peripheral nerves in scurvy. In this paper the neurologic symptoms in 150 cases of scurvy encountered during the World War are presented. Sensory disturbances, occurring principally in the lower limbs, were found in forty-five patients. Paresthesia of various forms and pain comprised the subjective symptoms, and the pain in many cases persisted a considerable time after the ordinary signs of scurvy cleared up. Objective symptoms manifested themselves chiefly by hyperalgesia and partial anesthesia. In most cases the sensory disturbances were of a patchy distribution over one or both legs, occurring mainly on the outer side of the leg or dorsum of the foot; in a few cases they were symmetrical, as occurs in an ordinary case of multiple neuritis; in one case they were present only around a small area of the trunk. The knee and ankle reflexes varied from exaggeration to absence, and in many cases were unequal. Nerve trunk and muscle tenderness were characteristic. The ordinary signs of the disease usually were present in the form of bleeding and spongy gums, swelling and edema of the legs, associated in many cases with subcutaneous, intramuscular and subperiosteal hemorrhages; the latter were inflammatory in character, for local heat, redness, and swelling always could be demonstrated. The author regards the mode of production of symptoms as the result of a toxic-nutritional disturbance of the nerves associated with trauma from the pressure caused by the hemorrhages.

STACK, Milwaukee.

Society Transactions

CONGRESS OF ALIENISTS AND NEUROLOGISTS OF FRANCE AND OF FRENCH SPEAKING COUNTRIES

Geneva, Aug. 27, 1926

THE BABINSKI SIGN. ITS CHARACTERISTICS, MECHANISM AND SIGNIFICANCE. AUGUSTE TOURNAY.

This is a long, thorough report of the Babinski sign by his former pupil and assistant. It includes more data relating to an important sign recently described by Tournay in the ARCHIVES (13:592 [May] 1925).

THE REPORTED FACTS CONCERNING THE REFLEX

The report begins with a chapter devoted to Babinski's original descriptions. The quotation from the original description is worth translating in full:

"On the unaffected side, pricking of the sole of the foot produces, as is habitually the case under normal conditions, flexion of the thigh on the pelvis, of the leg on the thigh, the foot on the leg, and the toes on the metatarsus. On the paralyzed side, a similar stimulus also gives rise to flexion of the thigh on the pelvis, of the leg on the thigh, of the foot on the leg, *but the toes instead of flexing extend on the metatarsus* (italics in original quotation). The sign of the toes may appear in various 'formes frustes'; that is to say, the reflex may have characteristics partially pathologic and partly physiologic."

Tournay, quoting Babinski, cites as examples: "(1) Stimulus only produces extension in the great toe and only in the first two toes, and causes at the same time flexion of the last toes. (2) The toes spread when the external portion of the plantar surface of the foot is stimulated, and flex when the internal portion is stimulated. (3) The reflex, no matter which part of the plantar surface of the foot is stimulated, is manifested sometimes by flexion, sometimes by extension of the toes. As a general rule, it is the first stimuli which produce flexion."

A considerable number of important facts are then emphasized. The sign is present in injuries of the peripheral neuron that paralyze the antagonists of the digital extensors ("Babinski périphérique"). Peripheral lesions may also prevent the sign from occurring. It may be absent if the pyramidal tract is diseased and there is at the same time another central lesion affecting the extrapyramidal pathways; for example, areas of softening in the basal ganglia, in the thalamic syndrome of Dejerine and Roussy, and in lesions of the mid-brain. In complete transverse lesions of the spinal cord above the segmental level of the reflex arc for extension and flexion of the toes, the sign may either be absent or present. It may fail to occur in the phase of shock and may appear later.

In infants, during and immediately after birth, the response is flexor, but within a few hours this changes to extension and remains so until about the sixth month. The change to flexion occurs on one side before the other, as a rule.

The temporary flexion response at birth is due to temporary asphyxia. In the fetus, the reflex is flexor until the third month of pregnancy and then gradually becomes extensor.

The reflex in normal persons is extensor during sleep. Under chloroform narcosis, in strychnine poisoning, and after attacks of epilepsy, it is also extensor. Temporary disappearance of the sign may occur if the patient is placed on his abdomen, with the legs at right angles to the thighs. The author himself described a temporary disappearance of a positive Babinski sign in jacksonian epilepsy.

MECHANISM

As stated, in the fetus, up to 3 months, the response is flexion. Thereafter, until about 6 months after birth, it is extension, and thereafter flexion. These changes represent three stages in the maturity of the nervous system. The first represents a purely spinal response, as was shown when the cervical cord was cut and the reflex was not altered. This recalls the frequent flexor response in transverse lesions of the cord. The next (extensor) stage shows the influence of a supraspinal extrapyramidal system; the third (flexor) stage, coincident with erectness, represents mature man as far as posture and movement go, and a fully developed motor cortex.

The relative importance of the rolandospinal and extrapyramidal controls may be stated as follows: (1) If the cortical influence is withdrawn (so-called "pyramidal tract lesion"), the response in extension depends on the intact extrapyramidal system. (2) If this is subsequently injured, the reflex in extension becomes flexor. (3) If a lesion of the rolandospinal tract is present, thus allowing the extrapyramidal system to produce extension, temporary irritation of the rolandospinal tract may cause the extensor response to disappear temporarily. This is the sign described by Tournay.

The following section gives the opinions of various authors approving or disapproving the idea that the Babinski sign is a minimal manifestation of the flexion reflex as seen in spinal automatic movements. This is followed by a short phylogenetic review and a section on the practical application of the test. The report is devoted to the mechanism of the sign rather than to a listing of the diseases in which it occurs. It sums up thoroughly, with abundant references to the literature, the facts bearing on the subject.

KRAUS, New York.

SOCIÉTÉ DE NEUROLOGIE DE PARIS

Dec. 2, 1926

PROF. ANDRÉ LÉRI, *Presiding*

Rev. *neuro.* 2:567, 1926

TONIC CRISES OF UPWARD CONJUGATE DEVIATION OF THE EYES OF ENCEPHALITIC ORIGIN. DR. LAIGNEL-LAVASTINE and DR. BOURGEOIS.

CASE 1.—A maid, aged 23, in 1925 had an attack of epidemic encephalitis. Four months later, she noted progressive difficulty in the movements of the right arm. Two months later the ocular disorders appeared. These consisted of crises of tonic contraction of the elevators of the eyes. During the crises, which persisted for eight or ten minutes, all lateral and lowering movements of the eyes became impossible and the gaze remained fixed upward. Caught in the street, the patient would have difficulty in finding her way; she would

see only the roofs and the chimneys. The crises came irregularly two or three times a day and were accompanied by anxiety. At the same time spasmodic phenomena of myoclonic type affected the depressors of the jaw, bringing about involuntary opening of the mouth.

Examination of the patient revealed a parkinsonian syndrome of the right side, characterized by rigidity with loss of automatic movements, cog-wheel phenomenon and hypertonia of the muscles of this side, with exaggeration of the postural reflexes and persistent contraction of the tibialis anticus. Marked vagal hyperexcitability was present. Pressure on the eyeballs forced down the pulse rate from 100 to 36; the solar reflex was negative. Treatment by atropine produced great improvement, and the cessation of such treatment for a few days brought a return of the spasms.

CASE 2.—This girl, aged 19, in 1920 had epidemic encephalitis. In February, 1926, she developed crises of tonic spasm of the superior recti with fixation of the gaze upward. These crises lasted for an hour sometimes and came on several times a day so that the patient was obliged to stop work. With the ocular crises, myoclonic contractions of the point of the chin occurred, which were incessant but to a certain extent were under the patient's control. There were no signs of parkinsonism. The oculocardiac reflex was greatly exaggerated (from 88 to 32). The patient also presented a band-like distribution of melanoderma, which dated from infancy, affecting particularly the lower part of the trunk and the roots of the limbs but not the genitalia. No neurofibromas or mollusca were present.

REMOTE SEQUELS OF EPIDEMIC ENCEPHALITIS. DR. H. FRANÇAIS and DR. J. LANÇON.

A printer, aged 57, became ill in 1908, at the age of 40, with the appearance of brisk myoclonic twitches in the muscles of the neck and upper limbs. They came on at night in an attack lasting four hours, and subsequently recurred in periods of corresponding duration, later extending to the four limbs and lasting about six months. They were more marked on the right than on the left. The following year there was some dysarthria, and since then the patient has spoken rapidly in a monotonous tone. About 1912, attacks of spontaneous nystagmus were observed. At present, the rapidity of speech is peculiar. In counting aloud and in reciting, the first words are emitted distinctly, but speech becomes more precipitous and finally incomprehensible. Respiratory movements are about normal but occur at the rate of 22 a minute. Writing is normal. The patellar reflex is more prompt on the right side, and the leg is extended almost completely on the thigh instead of immediately falling to its former position; it describes a series of oscillations decreasing during a period of twenty or thirty seconds. This phenomenon is brought out not only by percussing the patellar tendon but even by pressure on the leg or by making a sudden extension of the leg. Repeated stimulation is followed by a reduction in the intensity of the reaction. Patellar clonus is present on the right, and the achilles reflex is also exaggerated, with ankle clonus. On the left side the tendon reflexes are a little lively but there is no clonus. The plantar reflex on the right is in extension and there is exaggeration of all the spinal automatic reflexes. There is no muscular rigidity or disturbance of objective sensibility.

The symptoms in this case resemble those found in striate syndromes. There are intermittent tics in the region of the left shoulder, together with tachypnea and tachyphemia. Both can be controlled voluntarily, but as the man speaks

the syllables run faster and faster. The disorder in the reflex activities of the limbs is probably also important and agrees well with the phenomenon which has been described as the hypertonic pendular reflex. The beginning of these troubles seems to have coincided with an attack of epidemic encephalitis in 1908. It is worth remarking that this patient does not present any rigidity or mask-like expression.

MEDULLARY COMPRESSION IN THE MID-THORACIC REGION WITH SYNDROME OF FROIN IN A SYPHILITIC PERSON. DR. O. CROUZON, DR. T. ALAJOUANINE and DR. P. DELAFONTAINE.

When paraplegia develops progressively in a syphilitic person and the serologic reactions are positive, one is led to suspect syphilitic myelitis. The coexistence of xanthochromia and massive coagulation of the spinal fluid, which is not exceptional with lumbosacral myelitis, is unusual when the myelitic syndrome occurs in the thoracic region. Medullary compression is readily demonstrated by hydrodynamic studies and by arrest of iodized oil 40 per cent in the subarachnoid space. In the presence of such a spinal subarachnoid block, the determination of its nature is difficult. It may be caused by meningitis or by some other cause of compression.

A woman, aged 24, developed a paraplegia suddenly in April, 1926. There were a few prodromal symptoms: vasomotor disorders in the left leg in 1922; dragging the left leg and frequent stumbling; in 1923, rigidity and insensibility in intercourse. These symptoms were intermittent at first, but later became permanent. There was no vesical disturbance at this time. In 1923, she also complained of dizziness, particularly in bending forward, but there were no disturbances of vision; in the latter part of this year she had paroxysmal pain in the anterior portion of the thorax. In 1924, there was severe headache almost daily during certain weeks. In 1925, lightning pains appeared in the left great toe. In the beginning of 1926, the headache grew worse; the pain in the thorax and toes persisted, and there appeared motor disorders resembling those of intermittent claudication, disturbances of equilibrium, pains in the left ankle and a burning sensation in the anterior part of the left leg. On April 8, while returning from work, the patient fell several times and finally was unable to raise herself. She stayed in bed for twenty-four hours and was then able to walk with a cane and even went out to buy things for the house but complained of frequent loss of balance. In May, a lumbar puncture revealed xanthochromic fluid coagulating *en masse*. The blood Wassermann reaction was strongly positive. No benefit followed intensive antisyphilitic treatment, but the disease progressed and involved the right lower limb, which heretofore had been free.

Examination on entrance to the clinic revealed complete spastic paraplegia in extension. The motor disorders predominated on the left while the sensory disorders were more marked on the right. The abdominal reflexes were abolished. The power of the abdominal wall on the left side was diminished. There was complete anesthesia of the feet and legs up to the middle third, with hypesthesia on the right side in the rest of the limb and up as far as the umbilicus. The same disturbances were fairly marked for pin prick, heat and cold. The sense of position in the toes was severely affected. Bony sensibility was disturbed, particularly on the left side. The sense of vibration was absent. There was urgency of urination but no involuntary evacuation. Lumbar puncture revealed 6 Gm. of albumin and 3 cells per cubic millimeter; the Wassermann reaction was positive; the colloidal benzoin reaction was

positive, 22222200000012220. Following the puncture, the patient complained of severe girdle pains in the region of the xyphoid. Further lumbar punctures revealed the same observations. Punctures between the seventh and eighth thoracic vertebral yielded fluid that coagulated in mass after about two hours. Puncture between the sixth and seventh cervical vertebrae six weeks later yielded a normal fluid except for a positive Wassermann reaction.

Iodized oil 40 per cent was injected between the seventh and eighth thoracic vertebrae. This was not painful. Three hours later a roentgenogram showed a mass of the oil in the sacral region and a few drops opposite the last thoracic vertebra. Four days later, the same masses were found. More iodized oil 40 per cent was later injected between the sixth and seventh cervical vertebrae, which brought on fever, headache and pains in the back and shoulders. The roentgenogram showed complete arrest with a concave lower level opposite the fifth thoracic vertebra.

This case shows the difficulty, in the presence of positive syphilitic symptoms, of interpreting a syndrome which under other conditions would be typical of medullary compression. It also shows that the test with the iodized oil yields important information in regard to the subarachnoid space.

DISCUSSION

DR. SICARD: According to the roentgenographic appearance of the iodized oil 40 per cent this is a tumor, and syphilis is not directly responsible. I have described the pseudotumor forms of syphilis with Haguénau and Lichtwitz, but the evolution of such cases is not at all similar to that observed in this patient. Since medical treatment has failed, a surgeon should be called. He can be assured of finding at the level indicated by the oil an obstacle that he might be able to remove.

CRURAL PARAPLEGIA DUE TO EXTERNAL TUMOR IN THE THORACIC REGION. OPERATION; RECOVERY. DRS. J. BABINSKI, A. CHARPENTIER and J. JARKOWSKI.

Madame G., aged 53, was healthy until the spring of 1925, when she noticed hypesthesia of the anterior aspect of the thighs. Later she noticed weakness of the lower limbs and in June, 1925, she had difficulty in walking. There were no root pains and the sphincters were normal. The following December the patient walked with great difficulty. The sensory disorders rose to the nipple line. A test with iodized oil 40 per cent was made and a half hour after the injection the oil was found along the vertebral column, the largest collection at the seventh cervical vertebra. Three hours later it was all in the sacral sac. Only two small drops were left opposite the fifth cervical vertebra. The test therefore, was negative. During the following months the condition became worse and in May, 1926, the patient was bedridden, with complete paraplegia in extension and characteristic signs, both motor and sensory, extending up to 3.5 cm. above the nipple line.

Instead of repeating the injection of iodized oil 40 per cent by the cisterna magna, the patient was inverted and one of the collections of oil in the sacral sac broke up into several small masses and was finally arrested at the level between the third and fourth thoracic vertebrae. Operation disclosed an extradural tumor at the level noted. In the hours following operation, the condition improved and sensibility returned rapidly. Three months later the patient could walk with assistance, although there were still signs of pyramidal disease. The tumor appeared to be a meningoblastoma of epithelial character.

DISCUSSION

DR. SICARD: I have not observed such cases; the oil test has always given exact information, but for the past year in doubtful cases I have submitted patients suspected of spinal compression to fluoroscopy during the test. The mass of oil can be seen clearly to run in the subarachnoid space. Just as in the examination of a stomach or esophagus, the information furnished by spinal fluoroscopy seems superior to that given by straight roentgenology.

STUDY OF THE SENSORY DISORDERS AFTER DORSAL RHIZOTOMY. REMARKS ON SHERRINGTON'S LAW. DR. J. A. SICARD, DR. J. HAGUENAU and DR. C. MAYER.

After section of the dorsal roots, we have found several facts which appear paradoxical if the law of Sherrington is interpreted literally. In our first cases, patients with causalgia continue to suffer and to present only limited zones of anesthesia after the rhizotomies. We believe that the reaction was due to the hyperesthetic sympathetic system, and we insisted that in these patients an extensive rhizotomy should be performed. Dr. Robineau performed an operation of this type on another patient and the recovery was immediate, but there again we discovered a variation from the law of Sherrington. It seems interesting, therefore, to study the sensory disorders after rhizotomy in a patient without causalgia.

A woman, aged 63, complained of severe intercostal neuralgia for seven years, which finally led her to consider suicide. It was limited to the left side, continuous, and corresponded to the territory of the seventh and eighth thoracic roots. The pains came by crises, becoming more and more frequent with shorter intervals between. No analgesic stopped them. Objective signs were not elicited in regard to the nervous system. The cerebrospinal fluid was normal. The test with iodized oil 40 per cent was negative. There was no suggestion of syphilis and no albumin in the urine.

Other therapeutic measures having failed, we considered that operation was indicated, and the dorsal roots from the fifth to the tenth thoracic vertebrae inclusive were sectioned. On regaining consciousness, the patient no longer suffered. The postoperative course was excellent, and in spite of her age, the patient has gone home completely cured. Sensory disorders following this operation run between a line below the nipple and a line through the umbilicus. The anesthesia is diminished in the axillary region, and in the back there is only slight hypesthesia. The disturbance is equal for touch, pain and temperature. We wish to point out the complete success of the operation, although we cannot as yet say whether it is permanent. This operation promises well in conditions in which the sympathetic nerves are not involved. It may also be noted how well the aged patient bore the rhizotomy. The freedom from shock was probably due to absence of manipulation of the cord.

The zone of anesthesia in the anterior thoracic region is larger than we would have expected. The upper limit is exactly at the level of the highest root cut. The lowest limit is at the limit of the lowest root cut. According to Sherrington's law, we should not have been able to demonstrate anesthesia above the sixth or below the ninth thoracic level because the marginal areas receive fibers from the fourth and eleventh thoracic roots respectively; these roots were not divided. The limits of anesthesia are such that in our case we might assume that each cutaneous segment receives sensory fibers from a single spinal root. Second, the absence of anesthesia in the thoracic region

close to the vertebra is a fact that we can only point out but which, if found in other patients operated on, is of a nature to modify completely the classic schemes of innervation because the section was made proximal to the emergence of the posterior paravertebral sensory fiber.

HEMICHOREA OF THALAMIC ORIGIN. DR. FOIX and DR. BARIÉTY.

The patient presented a tuberculous empyema and a slowly progressive neurologic syndrome. This was characterized by left hemiparesis, with involuntary movements of the same side, athetotic in type. When voluntary movements of the upper limb were performed, there was intention tremor and asynergic phenomena as well as athetoid postures. The same symptoms were found less marked in the lower limb. The reflexes were increased; the Babinski sign was negative. The necropsy, in addition to pulmonary tuberculosis, showed a large tubercle in the thalamus, touching the posterior limit of the internal capsule. The corpus striatum was intact.

A SUPERIOR CEREBELLOTHALAMIC SYNDROME. DR. C. FOIX, DR. J. A. CHAVANY and DR. P. HILLEMAND.

The cerebellar nature of disorders of coordination and certain thalamic syndromes was first suggested by Vincent. One of us, in collaboration with Pierre Marie, reported a series of cases in a work on cerebellar hemiplegia; this constitutes the superior variety of the clinical types of cerebellar hemiplegia described in the treatise of Thiers. It is our opinion that thalamic incoordination is a complex phenomenon in which, besides an asynergia, ataxia and intention contracture play a part; asynergia, however, is most important, so that one might say that thalamic incoordination is above all a variety of cerebellar asynergia. A lesion bringing about this condition might be supposed to affect the subthalamic centers, but except in the unusual cases of injury to the red nucleus described by one of us with Chiray and Nicolesco, the real lesion is in the thalamus and leaves the others untouched. This lesion always occupies the posterior-inferior external portion of the thalamus, and by its association of superficial and especially deep disturbances of sensibility with the incoordination makes a characteristic picture. The involvement of intrathalamic cerebellar fibers and of the thalamic relay of the superior cerebellar peduncle is presumably the cause.

The variety we report today is unusual because the sensory disorders were mild and the cerebellar disorders were present almost typically, accompanied by only slight intention contracture which might give way to treatment. The external portion of the thalamus was involved in its upper part. The suboptic region and the red nucleus were intact. Therefore, we have to deal with a variety of the cerebellothalamic syndrome, and this case shows that a lesion affecting the upper half of the upper thalamus may be accompanied by cerebellar phenomena. It is true that the lesion is not limited to the thalamus. It affects also the retrolenticular portion of the internal capsule, interrupting the communication between the thalamus and the cerebral cortex. It is not impossible that this part of the lesion plays a rôle in the genesis of the cerebellar phenomena. One of us, with Thévenard, reported a case of pseudo-cerebellar phenomena of cerebral origin. However this may be, involvement of the upper portion of the thalamus should first of all be taken into consideration; in any case it cannot be excluded.

TABETIC ARTHROPATHIES AND INTRASPINAL TREATMENT WITH BISMUTH. DR. GONZALO R. LAFORA.

A large tabetic arthropathy of the left knee, of eighteen months' duration, was reduced rapidly after the intraspinal injection of soluble salts of bismuth. Improvement began after two injections, the articular swelling disappearing after five months. The deformity of the limb disappeared almost completely at the end of this time, and the patient regained his ability to walk. This improvement is still present after two years.

ARTERIOSCLEROTIC DEMENTIA WITH GYNecomASTIA. SOFTENING OF THE STRIATUM WITHOUT CHOREO-ATHETOTIC SYMPTOMS. DR. URECHIA and DR. MIHALESCU.

A vagabond, aged 50, presented mild achondroplasia and cardiac hypertrophy with aortitis and arteriosclerosis. The pulse rate was 56. The pupils were normal; lumbar puncture gave negative results, and the blood Wassermann reaction was negative. There were gross memory defects, indifference, apathy, lack of attention and confabulation. In July, 1924, there was a slight stroke, followed by flaccid paralysis of the right upper limb and loss of tendon reflexes. Six days later, the reflexes returned and became exaggerated. The patient could use the paralyzed limb slightly. About a month after the stroke there was manifest symmetrical hypertrophy of the breasts, and on palpation they seemed to contain glandular tissue. The testes were atrophic. The dementia had progressed to complete apathy. The patient wasted rather rapidly, could hardly stand, and had anarthria and paresis of the palate. In September, two months after the first stroke, he was found in coma with dilated, rigid pupils, and died four days later.

At necropsy the calvarium was 15 mm. thick in places; the meninges were thickened; the brain was atrophic, especially in the frontal portions and more so on the right. There was a small subcortical softening in the lower third of the ascending frontal convolution. The basilar arteries were sclerotic. The left putamen was the seat of infarction which affected the external capsule, claustrum and part of the caudate nucleus. The internal capsule and globus pallidus were not involved. In the base of the brain the lesion extended close to the area of Reichert and the infundibular region. The testes and thyroid were small and sclerotic. The mammae were as large as small oranges and contained connective tissue and a little glandular substance. Microscopic examination of the testes revealed marked fatty degeneration with rare spermatozoa. The interstitial gland was poor in lipochrome, and many of the cells were empty. In the mammary gland there were several acini with many rows of cells. In the brain there was pronounced fatty degeneration in various locations, with chronic and intense lesions. The neuroglia was hyperplastic, and there was much sclerosis and hyaline degeneration of the vessels, especially of the small vessels of the cortex, as described by Alzheimer.

The most interesting feature in the case was the gynecomastia. This dystrophy was related to an evident atrophy of the testes. It has been noted equally in those affected by hypothyroidism, acromegaly, hypopituitarism and status thymicus. The atrophy and the secondary hypertrophy of the breasts followed the stroke within a few days. The softening, however, did not involve the nuclei of the infundibular region or the Reichert nucleus and was only on one side. An indirect relationship between the tuber and gynecomastia is probable. It has been shown that alteration of this region is capable of

producing testicular atrophy and the adiposogenital syndrome. In this case the severest lesions were found in the supra-optic nuclei. In another case, a report of which was published with Elekes and which also presented diabetes insipidus, the nuclei also presented severe changes. We should not affirm, however, that changes in these nuclei led to interstitial atrophy.

NEW YORK NEUROLOGICAL SOCIETY AND THE SECTION
OF NEUROLOGY AND PSYCHIATRY OF THE
NEW YORK ACADEMY OF MEDICINE

Joint Meeting, Dec. 7, 1926

I. ABRAHAMSON, M.D., AND T. K. DAVIS, M.D., *Presiding*

HIGH CERVICAL LESIONS IN THE GUISE OF COMBINED SYSTEM DISEASE. DR. E. D.
FRIEDMAN.

The diagnosis of a level lesion in the cord seldom offers serious difficulties, although one may not always be certain of the nature of the pathologic process which produces the level signs. I have observed two cases of high cervical cord lesion in which the early signs pointed to combined system disease. It was only later in the course of their development that the evidences suggestive of a level lesion became manifest.

In case 1, a schoolboy, aged 14, complained of increasing weakness of the lower limbs. Soon afterward the upper extremities also showed a loss of power. The patient had shortness of breath and palpitation of the heart. There was incontinence of the urine at times. Priapism occurred at intervals. He was admitted to Mount Sinai Hospital in July, 1920. He presented labored breathing, tilting of the head with the chin directed to the left, nystagmus in the horizontal plane, motor weakness, more marked on the left, disturbances in joint mobility and vibratory sense in all four extremities, astereognosis in both hands, ataxia with tabetic athetosis in the hands, general exaggeration of the deep reflexes, diminution of the lower abdominal reflexes, a bilateral Babinski sign, spastic-ataxic gait, a positive Romberg sign and cerebellar phenomena, more marked on the left. The general medical status did not show any abnormalities. On one occasion, sugar was found in the urine. The spinal fluid was normal. The blood Wassermann reaction was negative. The case was considered a combination of the Friedreich and Marie forms of ataxia.

The patient was discharged from the hospital, Aug. 20, 1920. About four months later, he was admitted to Montefiore Hospital with the same complaints, in an aggravated form, however. The pyramidal tract signs had become more pronounced. He now exhibited cross-legged progression. In addition to the disturbances in posterior column sensation and the cerebellar manifestations, he now presented an area of hyperesthesia in the distribution of the upper cervical segments and tenderness over the upper cervical spine. Below this hyperesthetic zone, there were mild disturbances in pain and temperature sense. He rapidly developed the signs of a transverse lesion of the upper cervical cord and succumbed.

The results of the autopsy follow: In the region of the foramen magnum, the upper cervical cord was found compressed by a mass springing from the odontoid process. This was composed of dense fibrous tissue in which was embedded a bony nodule (osteofibroma).

The second patient, a watchman, aged 55, who was admitted to Bellevue Hospital in July, 1924, said that for seven months prior to admission, he had had sharp pains in both shoulders, radiating down the left arm and even into the left lower extremity. Four months later, he noted a similar pain in the right arm. He also noticed a sharp pain in the left side of the neck radiating upward. He soon found that he was unable to execute finer movements with either hand. Walking became increasingly difficult, and there was some hesitancy in voiding urine.

Physical examination revealed moderate emphysema and mild atherosclerosis. Neurologic examination showed weakness of the upper extremities, more pronounced on the left, and paresis of both lower limbs. There did not seem to be any disturbances in superficial sensation, but joint mobility and vibratory sense were impaired from the shoulders down. There was astereognosis in both hands with tabetic athetosis and ataxia. The gait was spastic-ataxic. There was a positive Romberg sign. The abdominal reflexes were diminished; the deep reflexes were exaggerated. A right Hoffman and bilateral Babinski signs were present. The chief symptoms were those referable to the posterior and lateral columns. The spinal fluid was normal, except for a tendency to a general paralytic type of gold curve. Gastric analysis revealed hypochlorhydria. Evidences of pernicious anemia were not present.

It was thought that the condition might be a capsulothalamic lesion on a degenerative basis. It was difficult, however, to reconcile the diagnosis of a cerebellar lesion with the absence of any changes referable to the cranial nerves.

The patient was discharged for further observation but was readmitted in January, 1925, with the same complaints, but with increasing weakness. Definite atrophy and fibrillary twitching were now present in the muscles of the left shoulder girdle. The sensory disturbances were the same as those previously noted, but there was now demonstrated an area over the left shoulder, in the form of an epaulette, in which pain, tactile and temperature senses were impaired. The patient held the head rather stiffly. Lumbar puncture now revealed manometric block and mild xanthochromia. The sensory changes soon extended upward to the second cervical level. The faradic responses in the left deltoid and biceps muscles were diminished. Fibrillation was observed in both trapezius and sternocleidomastoid muscles, but more especially on the left. Fluoroscopic examination of the diaphragm showed limited excursions on the left side. Bence-Jones bodies were not found in the urine.

It was now felt that the lesion existed near the foramen magnum with anteroposterior compression of the cord at the second cervical level. It was advised that an upper cervical laminectomy with partial removal of the foramen magnum be performed on May 1, 1925.

There was not any evidence of bone disease. The dura appeared whitish and dense. The arachnoid seemed thicker than normal and was definitely adherent to the cord and to the dura. Overlying the first and second cervical segments was a dense whitish mass that seemed to grow out of the cord. It was thick and its caudal extremity spread out finger-like over the cord. Attempts to find a line of demarcation between this mass and the cord were unsuccessful. The cord was adherent to the dura on either side for a distance of two or three segments. The upper border of this mass presented a sharp

line of demarcation. This adhesive process seemed completely to obstruct the circulation of the cerebrospinal fluid. Except for the adhesions and the mass mentioned, the cord appeared normal. The pathologic condition explained the spinal block, and the scar tissue probably accounted for the pain in this area. It was considered that the process was inflammatory rather than neoplastic (possibly syphilitic in origin). A microscopic study was not made. The patient survived the operation only twenty-four hours. Autopsy was not performed.

DISCUSSION

DR. BERNARD SACHS: Dr. Friedman has presented his thesis in a splendid way. The difficulties which have beset him, others have also encountered; not only the difficulty of making a differential diagnosis in such cases, but also the increased difficulty which is encountered when the lesion is in the mid-dorsal region. In the cervical region there are bound to be, sooner or later, symptoms which point to involvement of the brachial plexus. This condition has existed in a number of cases which I have had under observation. There is often no evidence of a level lesion with slight nystagmus, which suggests that the case might be an atypical disseminated sclerosis, but there is always the possibility of a slowly growing tumor in the mid-dorsal region. As I review the cases which Dr. Friedman has presented, I do not know that one could have made any different diagnosis in the earlier stages. It was only when the sensory level symptoms appeared that the diagnosis should have been made. The cases are of extreme interest, and often a definite diagnosis cannot be made until the postmortem examination has been made or some unfortunate surgical experience proves the event.

DR. I. ABRAHAMSON: I wish to call Dr. Friedman's attention to a patient in the Mount Sinai Hospital who for a long time presented the syndrome of multiple sclerosis. She then developed signs and symptoms of amyotrophic lateral sclerosis with respiratory difficulty, just as did Dr. Friedman's patient. Later a definite level in the cervical cord was established. The disturbance of the spinal thalamic sensibility was never marked. The level was established by the zone of hyperesthesia; this patient also had vesical trouble, mainly incontinence. An operation was performed by Dr. Elsberg, and the neoplasm found at the level indicated. The patient died thirty-six or forty-eight hours after the operation. An important point in the differential diagnosis of high cervical tumors is the existence of early vesical trouble, not retention, but occasional incontinence. The boy described by Friedman, if I am not mistaken, also showed incontinence of urine from time to time, which, combined with respiratory embarrassment, made me consider the probability of a high cervical tumor. In a series of cases collected by Dr. Grossman and myself, we found incontinence of urine a not infrequent symptom of high cervical lesions. In this boy at the hospital I suspected a level lesion, but we could not prove it, as sensory level signs were absent. At the Montefiore Home, however, a definite diagnosis was made of a high cervical neoplasm; but the boy was not in condition for an operation. In such cases it is important to look painstakingly for level signs. Dr. Friedman's second patient complained of considerable pain around the shoulders. The moment level symptoms, hyperesthesias or root pain are found, a neoplasm must be considered, and the possibility of operation determined.

DR. FRIEDMAN: Dr. Sachs has stressed the difficulties of diagnosis. When I spoke of the advent of signs of a transverse lesion of the cord I thought that

I made it clear that the diagnosis was not made antemortem. Four diagnoses were offered: intramedullary disease, atypical Friedreich's ataxia, central gliosis and extramedullary compression. One of the neurologists considered the case an atypical Friedreich's disease, even at the late stage, in spite of the fact that level signs had been present. The existence of vesical symptoms is important; but in some cases of combined sclerosis we may, as a terminal event, obtain evidences of a transverse level lesion. In such cases operations have been performed erroneously for tumor of the cord. When cases are viewed in retrospect elements can be discerned in both which are suggestive of a tumor of the cord. The boy presented the peculiar tilting of the head with the labored breathing suggestive of a high cervical lesion. He had occasional incontinence of urine and priapism, but the disturbance of spinothalamic sensation was conspicuous by its absence. There were not any hyperalgesic zones early in the disease.

In the second case, I believe if we had been able to get better cooperation from the patient, we might have demonstrated the hyperalgesic zone of which Dr. Abrahamson speaks and which we all feel is of great diagnostic significance. The patient was examined carefully by all of us for the existence of such hyperalgesia, but we could not definitely outline such sensory disturbances. It was only later when the shooting pain down the arm became more pronounced and the atrophy and fibrillation in the shoulder girdle more definite that the clinical syndrome became manifest. The stiff carriage of the head led us to probe more deeply into the disease, and then the diagnosis became clear.

HEMILAMINECTOMY. DR. ALFRED S. TAYLOR.

At the meeting in December, 1909, the original paper on "Unilateral Laminectomy" was presented. The condition is now more generally termed "hemilaminectomy." The majority of neurologic surgeons think the method does not have any advantages over the usual operation, "bilateral laminectomy," which has been perfected and made easy, but there are conditions in which hemilaminectomy has decided advantages. Special instruments, designed for the purpose, are essential for the satisfactory performance of this operation. With the use of these instruments it is possible to remove the laminae of one side so as to give an exposure fully as wide as that obtained in the usual bilateral laminectomy.

The exposure is favorable for the exploration of the cord with little manipulation. The following procedures have been performed repeatedly without damage to the cord: (a) Exploration of the vertebral canal at all levels (with lumbar lordosis and thick muscles the procedure is difficult and unsatisfactory). (b) Dorsal ramisection on one or both sides. (c) Unilateral chordotomy. This can be accomplished with perfect ease, but bilateral chordotomy cannot be performed. (d) Exposure of tumors of the spinal cord with their removal. This has frequently been done, the tumors varying from 3 to 5 cm. in length and from 1 to 2 cm. in diameter in all locations. They have been removed without evidence of damage to the cord from the manipulation. Intramedullary tumors have been explored and decompressed by splitting the cord, leaving the dura unsutured. One ventral chondroma in the cervical region was removed, with rapid improvement on the part of the patient. (e) Exposure of adhesive arachnoiditis simulating tumors. (f) Exposure of "meningomyelitis" simulating tumors.

Therefore, hemilaminectomy can be used with safety to the patient, and most of the procedures usually carried out through bilateral laminectomy can be accomplished through a hemilaminectomy.

The question is whether, under certain circumstances, hemilaminectomy possesses such decided advantages over the usual procedure that it should be the method of choice.

In hemilaminectomy it must be remembered that the laminae of one side and the spinous processes are left intact, together with their muscular and ligamentous attachments, which is a great stabilizing item. This is particularly true in the cervical spine. When complete laminectomy is performed the ligamentum nuchae is more or less destroyed, and the only supports left to the neck are the intervertebral disks and the ligaments between the bodies of the vertebrae and the articular processes.

Three cases are cited in which bilateral laminectomy in the cervical region was followed by dislocation of greater or less degree; in one case it led ultimately to death; in the third case it probably caused death; in the second case it was performed without trouble.

In the lumbar and sacral regions, if bilateral laminectomy is performed in the presence of a tendency to spondylolisthesis, the patient has little support against a recurrence of the disability, and there is not a bone so situated as to permit fusion of the spine or bone implant which would give sufficient rigidity to prevent this accident.

Ventral and ventrolateral tumors can be approached and disposed of through the lateral exposure natural to hemilaminectomy with far less manipulation of the cord than is feasible in the usual laminectomy.

Finally, it should be stressed that if hemilaminectomy is used for exploration and a condition is found which cannot be properly handled, it is simple to convert the exposure into a bilateral laminectomy, involving as much of the field as is necessary.

Various cases were cited to illustrate and prove the assertions made in the body of the paper. Lantern slides were also used.

DISCUSSION

DR. BYRON STOOKEY: I am afraid that I am one of those to whom Dr. Taylor has referred who did not do justice to this operation until Dr. Taylor had demonstrated its value and its possibilities. The aim of any surgical procedure should be to obtain the maximum exposure with the least disturbance of anatomic and physiologic function. For example, there is the change from the older method of exploration of the brain as done by Sir Victor Horsley, in which the bone of the cranial vault was removed without regard for cranial defect to the method of osteoplastic flaps now used, by which a flap of bone is turned down and again replaced, so that the patient is left with a minimal anatomic deformity and yet an excellent exposure is obtained. Until Dr. Taylor introduced this method of hemilaminectomy, bilateral laminectomy was the only procedure which was considered. I do not know why many surgeons have been opposed to this procedure, except that it is more difficult to do. It requires greater skill, technic, a longer time and also special instruments which Dr. Taylor has designed and without which the operation cannot be performed. If any one has tried this operation with ordinary rongeurs he has undoubtedly met with considerable difficulty, which has made the procedure without proper instruments almost impossible. With the special rongeurs devised by Dr. Taylor, adequate exposure of the spinal cord can be obtained. Many instances of

laminectomy are exploratory in character. Of the neoplasms most often missed at exploration, I think the ventral tumors, in particular the extradural tumors, are those most likely to be overlooked, even in a bilateral laminectomy. With a unilateral laminectomy the ventral tumors are particularly well brought into view. The dorsal tumors are readily seen in any event and are not likely to be overlooked, since they are exposed as readily as the cord itself. I helped Dr. Taylor perform a laminectomy on his neurosurgical service at Bellevue for a ventral chondroma which was small and placed in the midline, somewhat on the side of the exploration. This tumor was taken out without difficulty through the best exposure of the ventral surface of the spinal cord I have ever seen.

I have seen similar tumors which could hardly be reached by bilateral laminectomy. Consequently for a ventral tumor, hemilaminectomy to my mind is the procedure of choice.

How shall we know that a tumor is ventrally placed? I do not believe that one can make a diagnosis *a priori* in some patients, but not infrequently after a thorough neurologic study we have enough evidence to suspect a ventral tumor. In two instances at Bellevue within the last year, in the service of Dr. Kennedy and Dr. Taylor, ventral tumors were diagnosed before operation and an operation was successfully performed. There are two regions of the cord in which hemilaminectomy is particularly indicated, one the cervical and the other the lumbar region. A patient who had a cervical cord tumor removed by bilateral laminectomy made an uneventful recovery, but six months later he returned with more or less forward dislocation of the neck. I had never encountered this deformity previously in any bilateral laminectomy. I reviewed the original plates, and thought I saw a slight bone defect which was not appreciated by the roentgenologist or myself before the operation. It is two or three years since the operation, during which time he has had to wear a Thomas collar. He has now begun to have some union of the two bodies of the vertebrae, so that eventually I think he will be able to go without the collar. In the cervical region, where the vertebrae are so freely movable, hemilaminectomy is the procedure of choice, at least as an exploration, and until a pathologic condition of such magnitude is uncovered that it cannot be dealt with by hemilaminectomy. In the lumbar region hemilaminectomy is difficult and requires considerable skill and practice. However, a splendid exposure can be obtained. For the maintenance of the body posture, it is desirable to preserve in the lumbar region as much of the vertebrae as possible, and this operation, as Dr. Taylor has adequately pointed out, does permit one to obtain a wide exposure with minimal anatomic disturbance. I am sure that the patient in whom the roentgenogram showed a liquefied disk with some bone destruction, and on whom he was forced to perform bilateral laminectomy, will have had some difficulty in maintaining a proper posture. When there is bone destruction by a tumor, further loss of bone substance may be avoided by hemilaminectomy. I think that hemilaminectomy has a definite place in neurologic surgery.

DR. SACHS: I admire Dr. Taylor's conservative method and statements. Hemilaminectomy has everything in its favor. So far as the operation is concerned, in cases of cervical tumor it seems to be unquestionably better than bilateral laminectomy. In fact, the sad ending in one of the cases with the dislocation of the cervical bodies would make one hesitate to resort to bilateral laminectomy unless it were absolutely necessary. In the case of lumbar tumors, if results can be achieved by unilateral laminectomy, that would be the method

of choice. In all exploratory operations, I should say begin with a hemilaminectomy and then resort to the other if it is necessary.

DR. KENNEDY: I have seen the results of hemilaminectomy performed by Dr. Taylor, and they can be favorably compared with the larger operation of ordinary bilateral laminectomy. Sir Victor Horsley used to say that, from his observation, it took twenty years from the time of the introduction of a new idea for it to become accepted by the medical profession. It seems that this period of time has elapsed in a number of instances, and I do not think that Dr. Taylor should be disheartened by the time that must elapse before his method is accepted. I believe that during the next three years the operation which Dr. Taylor has been demonstrating to the surgical profession will be adopted largely, and that the exceptional operation will be bilateral laminectomy.

DR. TAYLOR: I wish to commend Dr. Sachs for having grasped the real point of the paper. The operation should be performed as an exploratory procedure, and then continued or not, as the individual case demands. It is so simple to make a bilateral laminectomy if necessary, and as far as necessary. If you can perform a unilateral laminectomy, well and good, if you cannot then you can complete the procedure in a few minutes, and get all the space you need without having wrecked the whole spinal column to start with.

THE MEDICAL EXPERT IN THE COURTS. DR. FOSTER KENNEDY.

The fight for the recognition of individual rights from Runnymede to the Great War is briefly traced. The part medicine has played in the past for the protection of the individual is cited in the conquering of yellow fever and the plague. In psychiatry, a prophylactic point of view is aimed at in examining the heredity and environmental stresses of the insane, and in the effort to comprehend their problems and aid in their adjustment. To abolish or mitigate mental and moral ills we shall have to do more than perform the priestly function of psychoanalysis. We must control heredity, we must segregate and prohibit from increase the proved unfit.

In the criminal courts, psychiatrists as a body are in the main reversing these aims. The individual criminal is being protected from society when society has as yet made no plans whereby, in the event of release on present charges, the criminal might be prevented from antisocial acts in the future. A public health attitude must be adopted in this matter, and it must be proclaimed that psychiatry cannot properly work through the existing criminal code, that justice is diverted by the absurdity of hypothetical questions, that twelve laymen cannot be expected to appraise nicely the degree of responsibility of a paranoic person or of a high grade moron, and that the differences of opinion between lawyers and physicians, and physicians and lawyers, buttressed, if not directed, by funds from opposed interests—gossiped and wrangled out in the courts—elevate crime, debase law and prostitute medicine.

The real point at issue in a trial in which the defense is a plea of insanity is not whether the mind was unsound, but was it sufficiently unsound so as to be unable to determine right from wrong, or if so, was the accused a victim of irresistible impulse to commit the act as charged in the indictment?

The question of responsibility for crime has been moot between lawyers and medical men from the time of Lord Erskine and the McNaughton case, in 1843, down to the present day, when calcification of the pineal gland has been advanced as a reason why a criminal, aged 18, should be shown preferential treatment for his murderous peccadilloes.

The whole system whereby a defendant employs and pays for medical opinion in the courts is wrong and should be abolished; a defendant should not have any more constitutional right to pick his medical expert than he has to pick the policeman who arrests him or the judge who presides at the trial. Acquittal on account of mental disease or semimental disease, often a feeble release of wolves to prey on the people, should not be tolerated any longer. Psychiatrists and jurists on both sides of the Atlantic have been feeling their way toward the realization of some of these ideas in the practical working of the courts. The American Institute of Criminal Law recommended recently the following program: 1. In all cases of felony or misdemeanor punishable by prison sentence, the question of responsibility should not be submitted to the jury, which will thus be called on to determine only that the offense was committed by the defendant. 2. The disposition and treatment (including punishment) should be based on a study of the individual offender by properly qualified and impartial experts cooperating with the courts. 3. A maximum term should not be set to any sentence. 4. Parole or probation should not be granted without suitable psychiatric examination. 5. In considering applications for pardons and commutation, careful attention must be given to reports of qualified experts. A sixth recommendation should be included in this program: A panel of persons of qualified medical opinion should be chosen, if possible from university and major hospital staffs, who would advise the consciences of the court, who would receive adequate remuneration from no private individual or corporation, but from the state and from the state only.

The third provision is of the highest importance, for when incurable people, such as morons, slightly feeble-minded persons, constitutional inferiors and mildly psychopathic persons have proved their instability by crime, we, as a "herd," have a right to demand their segregation probably permanently, but certainly for a prolonged period, depending on the natures of their eccentricities and of their crimes. Let us banish mawkish sugary sentimentalism, let the law do its duty and do it quickly. Let us put our knowledge at the disposal of the state and of the courts, but not ply for hire among unstable, eccentric or psychopathic persons and the dregs of the underworld.

DISCUSSION

DR. JOSEPH COLLINS: Aristotle said that a speech consists of two parts, the first, a statement of the case, the second, to make it good. Dr. Kennedy has stated the case well. I am not so sure that he has been so successful with the requirements of the second part. It is an indication of maturity, perhaps of crossing the Rubicon, that one concerns himself with expert testimony. There probably is no older member of this audience, who has not spoken or written on it in varying keys many times. Dr. Kennedy opens his address with some remarks concerning our neglect of society as a whole, and of our attention to the rights of individuals. There is an example of individualism, with not much concern for the group which constitutes society, going on in the world at the present time which seems to get the sympathy of a large number of the articulate people throughout the entire world, namely, the experiment in Italy. I am not so sure that the world is not witnessing an effort to get over the bulwark of liberty, and that this is not a continuation of our endeavor to make individualism of the greatest importance. The gravamen of this entire situation, as presented by Dr. Kennedy, is: (1) that the hypothetic question is an abomination, and (2) that the way of eliciting and obtaining expert testimony

should be changed. There is not any one here mean or contemptible enough to say a word in favor of the hypothetical question; everybody agrees; but it is like death and taxes; it is inevitable. Who is responsible for the hypothetical question? Who frames it? We frame it. There never was a hypothetical question that we experts were not asked either to frame or to supervise. We inject into the hypothetical question some objective which will permit us to answer in favor of the person or institution which employs us, and at the same time eases our conscience. There is a way by which the hypothetical question can be, if not cured, enormously improved: there should be but one hypothetical question; one which embraces all the facts that have been presented by the state and by those who represent the prisoner, and that hypothetical question should be asked the experts on both sides. If that were done, the hypothetical question would be relieved of the enormous charge that can be made against it, namely, that it facilitates injustice rather than justice. If we wish to help the legal profession in a way that will permit lawyers to avail themselves of our expert services we can do it by getting the Bar Association and the medicolegal associations to agree that the hypothetical question should be prepared in that way and in no other. The procedure of the hypothetical question is exactly the thing that we, as physicians, constantly face in reaching a diagnosis. Why should lawyers be denied a procedure that we find so useful and essential? In the hypothetical question we are asked to assume that so and so are the facts. When a patient is brought to me, and I am asked to pass on his sanity, I assume that what has been told me by those who brought the patient are facts, and then I can use whatever capacity for interpretation, detection or discrimination that I have to determine whether they are facts or not. That is exactly what the expert is called on to do with the hypothetical question, and that is what the jury is called on to do. The hypothetical question is exactly what the jury system is: an outgrowth of necessity; an evolution of the process of law. We cannot and should not get rid of it. We should improve it.

The four kinds of expert witnesses are the expert witness who does not know, but who does tell it; the expert witness who knows and cannot tell it; the expert witness who is truthful and the expert witness who is a liar. Dr. Kennedy has suggested a method by which expert witnesses should be called. I do not agree with him when he says that the individual does not have the right and should not have the right to call on any one that he chooses to give expert testimony. I have witnessed in a comparatively short life too many curtailments of the liberties of the individual promised by the Constitution. Why should a criminal be deprived of the right of calling expert witnesses to testify in his behalf? Until he has been proved guilty he should have the rights conferred on him by birth. I heard Dr. Sachs, twenty-five years ago or more, say in this Society that experts should be called in much the same way as Dr. Kennedy has suggested. He has waited longer than the twenty years of Sir Victor Horsley, and he is still a voice crying in the wilderness. I made a suggestion a year ago last January, in *Harpers Magazine*, that when expert witnesses were desired the Academy of Medicine should send to the presiding judge of the Appellate Division of the Supreme Court a list of names of men who are qualified by study, by character and by experience to give such testimony. These would be retained by the state as expert witnesses, and they should have a retainer, a yearly stipend; whenever an expert witness was needed one of them could be called on to give testimony, not for the state or the individual, but for the enlightenment of the court. I do not go so far as Dr. Kennedy; I do not believe that these witnesses should be what Madame

De Staël was to Benjamin Constant—a light for his conscience and a guide for his intelligence—but I should say that they would be instruments for the information of the court. Who are the people who give expert testimony now? Any physician who has seen more than one case is qualified as an expert. I need not say that it requires not only that one case be studied carefully, but hundreds, and over a period of years, before one has the slightest qualification to be entitled to be called expert. We have done little, in reality, to try to confine expert testimony to those qualified to give it.

Let me say one or two words about expert testimony in a celebrated case that has just been tried. Three expert witnesses, one of them formerly a deputy commissioner, went on the stand and said without qualification that the finger-prints of Willie Stevens were the finger prints that rested on a card found on the body of one of the murdered persons. Finger-prints are supposed to be an exact science. When the defense put in the case three men of apparently equal powers, one took the stand and testified that this was not so, and with one of those flashes of illumination, which Bacon has said is so material for success, threw on the screen an enlargement of the picture of the finger-prints and pointed out to the perception and intelligence of the jury and apparently to the satisfaction of the whole world that those finger-prints were not the finger-prints of Willie Stevens. Suppose the testimony of the first three experts had been accepted. Willie Stevens would now be languishing at the foot of the gallows. One half of all expert testimony is bunk.

One might readily gather from reading Dr. Kennedy's paper that prisoners who are declared insane go free. They do not. They go, as you well know, to asylums for the criminal insane. There is a choice between hell and Dannemora. Now that the former has been deprived of some of its terrors, a goodly number of criminals probably choose it. I am sure that they would choose Sing Sing. When an insane criminal recovers, and parenthetically a criminal recovers from insanity with the same frequency as does a priest and a reformer, then he is put on trial again. If he does not recover, he stays where he has been put, and that is punishment for any crime save bootlegging.

I do not understand what Dr. Kennedy meant by preferential rights or treatment in referring to the Loeb case. Those criminals received life sentences. That should satisfy any one or every one who is not gaited like Pekah. I think that criminals, despite us physicians receive just sentences in the vast majority of instances. They do not receive their punishment as soon as they should, for every one admits there is lamentable delay in bringing them to trial, but they are eventually punished. It is true that some of them are able to use money to their advantage. When the time comes that they will not be able to do this, we shall have reached the millenium.

There are two things to do: (1) change the hypothetic question; (2) adapt some means for the elimination of the crook as an expert. Dr. Kennedy has called your attention to the fact that some of the recommendations made by the American Institute of Criminal Law are most deserving; but I want to call your attention to the fact that three of those recommendations are already in effect. At the present time parole is not granted in this state without suitable psychiatric examination, and careful attention is given to every demand for parole. It is the increasing custom in this state and throughout the country, in the courts, to look into the history and environment of the offender most carefully before the sentence is pronounced. I am in full sympathy with Dr. Kennedy's closing sentence, providing that he will change one word. He says:

"Let us abolish sugary sentimentalism; let the law do its duty and do it quickly, and let us physicians put our knowledge at the disposal of the state and of the courts, but not ply for hire among unstable, eccentric and psychopathic persons and the dregs of the underworld." If he will change "not ply for hire" to read "not lie for hire," I am in full agreement with him.

DR. SMITH ELY JELLIFFE: It is interesting to hear once again of Runnymede and Magna Charta and to be assured from these and later glorious achievements so eloquently portrayed by Dr. Kennedy that it took so long for the individual to get any rights at all.

I sometimes doubt whether safeguarding the liberty of personal action has been so well acquired as the learned reader of the paper of the evening has assured us. In fact, I hope I do not appear somewhat hypercritical if I seem to detect in the opening sentences of this paper a blowing hot and a blowing cold—now it is the individual who has all the rights, now the masses. If the Great War was one for individual rights, and the bloodless struggle (I presume Dr. Kennedy is referring to the British general strike) one for the masses, wherein do we find that just discrimination that I feel sure our orator would counsel? Certainly not with us here in the United States in the prohibition movement—that monumental bit of legislation which would even deprive the future President of the Academy of Medicine of the right to prescribe for human beings what he considers right and wise for him to prescribe in the event the prescription should contain alcohol. Five chief justices of the United States as opposed to four chief justices of the United States presume to tell the physician what he should prescribe for sick humanity. Is this Runnymede—or Magna Charta—or just "blind" justice?

But this is possibly an aside from the issue we are called on to consider. No one, least of all myself, would dispute the gravity of the situation to which Dr. Kennedy, like many another before him, has pointed his finger in the second paragraph of this paper—11,000 homicides—nine-tenths of which I believe hinge on the issue I have just spoken of in prohibition. This is a terrible situation to contemplate, and the comparison with typhoid or Boer war material is not needed to make one shudder. But has Dr. Kennedy put his finger on the real spot when he calls this "rampant individualism"? It is a direct result of bull-necked legislation in its muddle-headed effort to try to treat medical and evolutionary problems by law.

Dr. Kennedy assures us that law is an instrument for the protection of society—but he forgot to say what kind of law. If he said that good law was an instrument for the protection of society, that is correct. But what about bad law? Is there no such thing as bad law? Are we all hypnotized by the belief that "LAW" is sacrosanct and one is a socialist or a bolshevik because he dares to distinguish or suggest that such a distinction is possible?

I believe in the high calling of medicine, both in its individualistic and in its prophylactic orientation. We did build the canal—and we have made it possible for millions to live longer and be happier than ever before, and we do not need a yellow press, or a *Saturday Review of Literature* to "tout" our achievements.

A dawn is slowly breaking when a man's mental equipment may be judged in a better light than his physical one. This, I believe, is what Dr. Kennedy refers to when he speaks of mental hygiene.

I said the dawn was breaking—but is it here? I shall never forget a story told by one whom we all loved—Dr. Pearce Bailey. In his slow grim way

he narrated how during the late war thousands of men were rejected as soldiers because they had "flat feet," but when it came to "flat heads" they were accepted. One can readily understand how flat-footedness almost became epidemic in 1917.

I regret to have to disagree again with Dr. Kennedy—this time not concerning his statistics, but concerning his allusions to the platonic—Aristotelian bipolarity. There is really no antagonism between vitalists and materialists—between functionalists and structuralists. Dr. Kennedy and I have married them repeatedly—with Dr. Kennedy I fear it is a "marriage de convenance"; with me it is a real love marriage, and function and structure are one—and mind is but one of the functions of living matter. Soma and psyche were born together, and let us hope ever will remain so.

But Dr. Kennedy advances by a prodigious leap when he says that "we as physicians must control heredity." Imagine the magic wand we must possess to alter a billion years of life's experiences on the globe; and also "we must segregate and prohibit from increase the proved unfit." Proved by whom? Five supreme court justices or by some other legally appointed authority? Who is more fit than another? and by what yard stick are we going to measure human personality?

Dr. Kennedy says that in our criminal courts "we as physicians act sometimes as brakes." "We would reverse the aims of the courts." I would like to challenge him directly. Of the 11,000 homicides he mentions, how many criminals have put in a defense of insanity through their lawyers? I do not think he can answer. In fact, I might even go further and state that the vast majority of the few who are apprehended would rather put in a defense of murder of a lower degree than put in the defense of insanity—and why? My personal experience has been that the vast majority of homicidal prisoners prefer to take their chances in jail rather than in the state hospitals.

When Dr. Kennedy says in the seventh paragraph of his paper that "society as yet has made no plan whereby, in the event of release on present charges, the criminal might be prevented from antisocial acts in the future" he makes, I believe, a serious misstatement. Society has made a number of plans, one of the most significant of which is to lock the individual up in a state hospital—Matteawan or Dannemora—in New York, and those are the two places in this state where the criminal does not wish to go. Every so-called criminal with whom I have come in contact has much greater fear of being considered a "nut" than the average man in the community.

I am glad to agree most cordially with Dr. Kennedy that the existing criminal procedure is an abomination; but I do want to insist in the same breath that we as physicians did not make it. I would tread a little more lightly on the matter of the hypothetic question. Here matters of procedure and modes of presentation of evidence get closer to the legal frame, and, I suspect, we may not know as much as we think we do in view of the growing body of experience in law. Because American jurisprudence does not accept our medical methods of investigation, it does not mean that the hypothetic question is absurd, even though we, as physicians, know it is riddled with medical absurdities.

And, finally, when Dr. Kennedy would attack the jury system, is he not treading rather roughly on Runnymede and Magna Charta? For, after all, are not the twelve men good and true a symbol of the community? I confess that from my own point of view, I have seen many a foolish jury, but, one may notice I say "my own point of view."

We have, let us say, forty-eight states in the Union; twenty-three have one series of tests; twenty-five have another; and they all vary as to the tests for responsibility for homicidal acts, testamentary capacity, contract capacity, ability to confer with counsel, etc. Dr. Kennedy does not particularize, and if he is quoting New York law on the issue of responsibility, he is misquoting. Across the river in New Jersey one can get away with an "uncontrollable impulse," but not in New York.

If Dr. Kennedy will go over Richard Olney's discussion and cross-examination of the state's witnesses in the Thaw trial on the issue of "insanity" as applicable to the defendant's ability to confer with counsel—an issue which by the New York test predicated "imbecility or idiocy"—he will note that the 1843 issues in England, dear to the medicolegal literati, have long ceased to be of significance in the United States.

And, finally, we have the recommendation of the American Institute of Criminal Law, on which Dr. Kennedy banks largely, although one suspects he is not altogether familiar with the evolutionary history.

To this program he adds a sixth recommendation—that a panel of qualified medical opinion be chosen, if possible from university and major hospital staffs—who would advise the conscience of the court and receive adequate remuneration. One is reminded of that Scotch story of an applicant for a medical degree who is told by his examiner that he would make a good "professor in the university" but a "damn bad doctor."

Yes, I admit that "woolly intelligentsia" receive their adequate exploitation in the *Daily Graphic* or the *New York American*, but these are only "rationalizations" of making silk purses from sows' ears; but, fundamentally, the twelve men good and true are not always such apes as one might be led to infer from the discussion.

DR. M. ALLEN STARR: After this brilliant paper, and the witty discussion by Dr. Collins and Dr. Jelliffe, all that I have to say will sound rather dull, but I wish to remind Dr. Sachs and others that this matter came up before the Academy of Medicine in 1892 and 1895, at the time of the extraordinary interest that was taken in the medical testimony in a certain case. There was then a great deal of sentiment among the members of the Academy of Medicine that some effort should be made by the members to remedy the state of affairs which was practically a scandal, that large numbers of so-called experts, who were not experts, could be brought into court, and establish the capacity of the medical profession, as Dr. Collins would say, for lying. At that time the president of the Academy, Dr. Edward G. Janeway, appointed a committee consisting of Dr. Dana, Dr. Janeway and myself to take this matter up before the Bar Association and the judges of the Appellate Division, then Judge Barnet, Judge Ingraham, Judge Gildersleeve and Frank Scott, all eminent members of the Bar. We met with them and tried to devise some method by which this scandal could be avoided in the future. The scheme that the committee evolved and the judges approved was that the plaintiff should be allowed to choose a medical expert; that the defendant should also have the power to choose a medical expert, and that the judge of the court before whom the case was coming up should himself appoint a medical expert, preferably a man who was either a professor in a college or at the head of one of the state institutions, like Matteawan or Dannemora, and that these three physicians should examine the person accused of insanity and bring a report into the court. The judges thought it wise to suggest that the fees of each of these

men should be settled at law by the judge and not be dependent on the capacity of the individual who might, perhaps, be willing to pay large sums; and that the jury should be guided in their verdict by the report. There, again, the difficulty at once arose that every defendant had the right to call the whole United States in his defense if he chose to do so, and this scheme would be considered an infringement of the liberty of the individual. That was the scheme adopted by the Academy of Medicine and the Bar Association, and I assure you, although Dr. Kennedy and Dr. Collins have thrown a certain amount of doubt on the lawyers, they were and are as anxious about the matter as we are; for the day before yesterday Henry Taft told me that the Bar Association at present has a committee appointed to study this matter and to try to work out some scheme to set right the matter of expert testimony before the court. I do not think the Bar Association is indifferent to this matter, and I think that if we could come to any definite conclusion or definite recommendation which we could send to them, it would meet with their approval, or at any rate with their favorable consideration.

There is a method which is in effect and has been in effect for twenty-five years in Germany, which has always commended itself to me. A person is arrested for a crime. The question comes up in his defense whether he is mentally unsound. In Germany, when a plea of that kind is brought up, the matter is suspended at once, and the person is committed to an entirely unprejudiced psychiatric institution, that is to say, not under the control of the court, where he is kept for from two to six weeks; while there he is carefully examined by physicians who are known to be experts; those physicians collaborate on a written report. You will see such reports all through the *Neurologische Centralblatt*, and in few instances are the reports over-ruled.

I am not sure that it would be wise to confine any suspect to Matteawan or Dannemora under the present conditions; but if we are going to have a psychiatric institute in New York under the direction of a man as capable as Dr. Kirby, it seems to me that we have a solution to this problem, and that we should suggest to the court and to the Bar Association that the German method be adopted as a way out of our present dilemma.

DR. M. OSNATO: I am wondering whether this discussion is timely or even necessary so far as the state of New York is concerned. If you will follow the career of the criminal from the time he is arrested until he reaches the death house at Sing Sing, you will see that from the psychiatric side he is well looked after. Recently, the policemen have been taught by Dr. Leahey of the Police Department, a well trained neuropsychiatrist, and by Dr. Gregory of Bellevue, in thorough systematic courses. These courses are calculated to enable officers to recognize the common symptoms of mental disease. The average detective is now more or less familiar with the outstanding features of mental troubles, so that the offender is observed by a partially trained person as soon as he is arrested. In the station the observation may be extended over several days. When brought before the magistrate, if there is any suspicion of insanity, the offender is remanded to Bellevue for observation, and Dr. Gregory's opinion is nearly always final and determines the judges' action. As Dr. Collins has already mentioned, the courts are supplied by the machinery of the probation system with the result of investigations which report on the social status of the accused and his behavior over an extended period of time. The judge who must sentence the offender has before him, therefore, data regarding his personality and behavior. If anything arouses the judge's

suspicious as to the mental fitness of the offender, commitment to Dannemora follows, after a period of observation at Bellevue.

During the criminal's stay in the Tombs, he is subjected to an examination by the Tombs' physician, who has considerable practical experience in the detection of mental disease. If, during the man's incarceration, mental disturbances are manifested, that fact is recorded, and the judge then appoints a lunacy commission consisting of a physician, a lawyer and a layman whose duty it is to call witnesses, including expert witnesses who are usually the Bellevue or King's County psychiatrists. When the case is tried, the judge is completely cognizant of its psychiatric features. The indicted insane offender must automatically be sent to Matteawan, if found insane.

Once convicted, if the mental situation develops after imprisonment, that situation is also provided for; after a commission finds the offender insane, he is sent to Dannemora. The commission usually consists of three of the superintendents of state hospitals whose duty it is to examine the offender and make recommendations. This commission also examines and reports on every man in the death house at Sing Sing.

I think you will find, if statistics were gathered on this point, that the difficulty is in the borderline cases in offenders who are wealthy or who have wealthy persons interested in them. They will often go to almost any extremity to prevent the proper administration of justice. Then one has to deal with the weaknesses of human nature, and as to that experts are not exempt. It is understandable why in such cases differences of opinion are found and often do occur among experts. I do not believe that in criminal cases one frequently finds on opposing sides mental experts who do not agree in their testimony regarding the mental status of the patient. So far as this state is concerned, I feel that this discussion is not timely, and it does not seem to me that the Society as an organization need do anything more about it.

DR. KENNEDY: I am much indebted to Dr. Collins for his admirable discussion, and interested in his plan for a list of experts chosen by reason of knowledge and character. This plan does not differ much from that which I suggested: that they should come from university faculties and hospital staffs, which, despite Dr. Jelliffe's doubts, would be likely to include a few good physicians and intelligent men.

I was also obliged to Dr. Starr for showing a plan to make experts expert, and for demonstrating the indefatigability of our effort in this direction. It is something, I think, that we physicians keep on trying, however little encouragement we get from results.

In reply to Dr. Osnato, I am glad to know that policemen used to be freudian and now are behavioristic. While he said that New York State did not require any of these recommendations, he spoke rather of the criminal without resources; wealth can obstruct justice, and he admits that rich people are able to interfere with the administration of justice; my remarks were really directed against our participating in that general abomination.

Judging from Dr. Jelliffe's remarks, I would seem to have uncovered in him a maelstrom of courtly conditioned reflexes and pro-expert complexes. To criticize the medical expert is not, I assure him, to besmirch the medical nest; but rather to try to cleanse the aesculapian stables. I am sure that Dr. Jelliffe would wish to lend his eloquence and erudition to this good end, rather than try to perpetuate a system which, while lucrative in a few places, is a blemish on the reputation of us all, and threatens the safety and dignity of society as a whole.

CHICAGO NEUROLOGICAL SOCIETY

*Regular Meeting, Dec. 16, 1926*JOHN FAVILL, M.D., *President, in the Chair*

A CASE OF VASOMOTOR SPASMS GIVING RISE TO EPILEPTIC PHENOMENA. DR. D. M. OLKON.

This boy, aged 13, was well developed for his age, well nourished and without recognizable physical defects. There was no history of serious diseases of childhood or of previous convulsions or other significant disturbances. About a year ago, in the school room, the boy suddenly felt a throbbing in the head which lasted for some minutes; it was followed by a similar feeling half an hour later, with some dizziness. After a short remission, during which he felt well, he had a third attack of throbbing in the head, followed by contractions and rigidity of the arms. The eyes had a staring look, and he became unconscious. He had five convulsive attacks one after another. He would regain consciousness for several minutes and then lapse back into spasms and unconsciousness, with twitchings about the face, mouth and neck. He did not bite his tongue; there was no vesical incontinence and no frothing from the mouth.

He was taken home and put to bed; the next morning he felt well and remained so for two months.

Oct. 16, 1926, at 4:00 p. m., while in the house, he again had a sensation of throbbing in the head, followed by "generalized" convulsions; he became unconscious and bit his tongue, but there was no frothing from the mouth nor incontinence. The next morning he felt dizzy with a "peculiar feeling of fear as if some one was going to grab him." Attacks continued irregularly, sometimes once a week, then three or four in one day. He was taking phenobarbital at this time, which failed to stop the attacks.

The patient was first seen in the dispensary of the University of Illinois College of Medicine, Dec. 3, 1926. A general physical examination revealed nothing of importance.

Neurologic examination showed a slight nystagmoid oscillation of the left eyeball, which was transient and would stop after two or three jerks. There were no other organic neurologic signs. All reflexes were intact and of good tone and there were no abnormal reflex phenomena. The eyegrounds, vision, accommodation, color perception, color displacement, fractional perimetry—all were within the range of normal.

He was taken into the Research and Educational Hospital for further study. Roentgenologic examination of the head revealed no abnormalities. Serologic studies of the blood and spinal fluid were negative as to pressure, Wassermann, Lange, Nonne-Apelt and Pandy reactions, cells, sugar, calcium and potassium, chlorides, urea and the xanthin bases. The blood chemistry and blood count were normal. The blood coagulation time, cell sedimentation and color index were all within normal range. Gastro-intestinal studies did not show any delayed function, either as to digestion or evacuation, and there were no pathologic elements in the excretions. The basal metabolic rate was minus 10.

The skin had an interesting appearance, and several photographs, taken at various times, gave a clue to the possible disturbances. Dermatologists call this condition "cutis marmoratus," which simply labels it. With the skin micro-

scope, the skin capillaries showed massing, meshes of thick elongated and tortuous capillaries which contracted and relaxed spasmodically, giving the superficial corium the color of alternating ischemia and anemia with the greater tendency toward contractions. Hence this "marmoratus" or mosaic appearance of the cutis was not a fixed color but changed from moment to moment as shown in the photographs and in the capillary beds. The skin of the hands and fingers, as well as the skin of the feet, when the capillaries were in extreme spasm, resembled the skin found in Raynaud's disease, erythromelalgia, intermittent claudication and scleroderma. However, in this instance, the skin was warm, moist and smooth, which is different from the former conditions.

Polygraphic tracings with the Boulitte polygraph in combination with the Pachon manometric oscillometer gave unique tracings showing vascular intermittent tetanic spasms. Kymographic tracings also showed similar spasms in the radials, jugulars and carotids. These irregularities in vascular tonus could be induced in this patient by various stimuli, by the application of cold, by heat, fear, anger, slight pain, etc.

The diagnosis made was epilepsy caused by vascular hypertonus, producing a kind of vascular tetany.

Since spasms can be moderately controlled, for a time at least, by antispasmodics, atropine in $\frac{1}{300}$ grain doses was given twice daily. Since then he has been free from attacks and goes to school; the skin looks much lighter in color.

I have four other cases similar to this and hope to report them in greater detail in the near future. Thus far, the results have been good with similar treatment. My purpose in this presentation is to delimit the so-called "idiopathic epilepsy group" and to look for definite extracortical causes in many such complaints.

THE PSYCHOLOGICAL EVALUATION OF SUGGESTION AND ITS USE IN MEDICINE WITH SOME EXPERIMENTAL DATA. DR. D. M. OLKON.

Suggestion, as Angell says, "has been more or less unintelligently used as far back as we have historical evidence." Modern psychologic research has revived the importance of suggestion and has made it an instrument for the use of the medical practitioner. Suggestion, from the therapeutic point of view, may be divided in accordance with Sidis' classification into direct and indirect suggestion. Direct suggestion is illustrated by the demand "Do this!" indirect suggestion by the statement "Other people do this, and achieve very desirable results." The first statement enters the mind as a positive mandate, and although this is an extremely effective method of attack in hypnosis, the normal reaction would often prove to be a negative one. The second statement enters the individual's consciousness in a persuasive way that is calculated to stir up ideas that will reinforce it, and so the reaction gets the color of individual thought rather than of mere obedience to instruction.

Suggestion is not abnormal or exceptional. There is no form of human behavior into which suggestion does not enter. It may be observed in family life, education, law, business, politics, art and religion. Every advertisement, every intonation in the voice has its suggestive power. The extreme of suggestion is called hypnotism. Suggestion may arise from without or from within. When from without, it always points to an object; from within, through memory and recall, it arouses in the mind some familiar experience. In effective suggestion, the mind imbibes the stimulus uncritically. It may imbibe the stimulus wholly in case there is a properly directed motor setting.

When attention takes a certain direction, a condition is set up in which conscious and unaware states tend to be augmented or inhibited, accordingly, as they are favorable or unfavorable to the continuance of the theme of attention. When one attends expectantly to a stimulus everything is favorable for its reception. Correspondingly, one is unprepared to receive any other stimulus and resists the development of any other presentation. Not only are the appropriate muscles of the sense organs held in preparation, but the sensory cortical centers are attuned, if not excited, because the image or thought of the coming stimulus is held in consciousness (awareness).

It is difficult to explain suggestibility. One may suppose that somehow the channels of motor discharge become especially wide open. Everyone is more suggestible in states of fatigue or emotional excitement. This simply means that attention goes over to the suggestion as a form of rest or abandonment and accepts uncritically the motor setting. Psychologically suggestion is only a particular form of attention. The physician has not the slightest reason to ignore suggestion. He should use it considerably and wisely. He must not forget that any word he speaks falls on soil prepared to an unusual degree by sickness, and he must realize the deep effect that his praise, blame, encouragement and discouragement will have.

To summarize the concept of suggestion, it may be said that when the motor setting is such that the man's attention is heightened to a responsive attitude, either through perception from without, as in the Müller-Lyer figures, or through a concept from within, as by recalling similar measures from a past experience, any antagonistic perception or concept is really prevented from entering; it is suppressed at once after entrance and is relegated to the marginal consciousness. Any action begun crowds out the impulse to opposed action. All that suggestion means, then, is action or reaction to a recall which is commensurate with a past experience. When one has accepted the suggested motor setting, he firmly believes it to be true for the time and is no longer open to any other form of belief or action; he remains attuned to the stimulus suggested.

The uses of suggestion are as vast and varied as life itself, but in the treatment of disorganized personality it is perhaps the greatest agent there is, when thoughtfully used. When suggestion is used for therapeutic purposes, one must use it in as specific a form as one would any pharmaceutical agent. It must assume the form, "do this" (or "others have done that") "that is true" or "that is untrue," "this is possible" or "that is impossible," etc., always in a definite set time. For example, if one wishes to suggest something for immediate effect, the suggestion must assume the form, "do this" for so many seconds or minutes. If the interval is to be longer, here again one must specify the exact number of hours, days, or weeks, as the case may be. Moreover, a motor setting must accompany every suggestion. When time is involved, the motor setting is the writing down on a special colored card the exact time the suggestion calls for, the card being placed where the individual will see it often. All these features bring perceptions that repeat the suggestion by association and recall. Gradually the suggestion becomes dominant; the individual no longer has any other version of the situation; he has succumbed to the suggestion.

When an individual is obsessed by a false belief one should not directly attack the belief, but aim to create by suggestion a new belief, which by virtue of its insistence and relation must crowd out the old. A case may be cited. Patient N. believed herself to be going insane. Any reference to insanity,

directly or indirectly, threw her into a state of extreme depression simulating melancholia. Her attention was directed to the fact that insanity manifests itself in motor acts quite different from sane acts, which she herself could discern. The direct suggestion given was that for thirty days she recorded daily any observations she might make on herself which would lead her to believe that her acts were unlike those of sane people. Her records showed her that her motor behavior did not differ from that of other people in the home, store, church, etc. It also pointed out to her that she talked logically, did her work efficiently and was alive to the world of events. She accepted the record, which was in this instance the motor setting, and henceforth crowded out the obsession of going insane.

Another case may help to illustrate what I mean by "a motor setting" in suggestion. Patient G. vomited on taking food during the later months of pregnancy. A week after delivery vomiting again set in when food was taken. In the absence of any gastro-intestinal clue, it was surmised that habit must account for the disturbance and that suggestion should be employed. The suggestion given was that she take one ounce of cold water ten minutes before eating and do a breathing exercise. She was told to inhale deeply and slowly for ten seconds and to exhale slowly for ten seconds, timing herself by a stop-watch. This she was to repeat twelve times, and the entire twelve times was to take exactly two minutes. The meal was then to be eaten and she was again to take one ounce of cold water and the breathing exercise was to be repeated in the same way. This was to be followed after every meal for three days, when the vomiting would stop. She was told that after the breathing exercise she would feel a warm sensation inside the abdomen. This would indicate that no vomiting could take place. On the third day the vomiting stopped.

Here the motor setting was the essential factor. The water, the stop-watch, the breathing exercise, and the warm sensation in the abdomen made the suggestion impressive and kept the attention active. The new perceptions were made focal by these agencies, which kept the suggestion active before the mind for a period long enough to prevent the former habit from expressing itself. The law of the transitoriness of habit doubtless operated here and helped the successful outcome of the suggestion.

To emphasize further that, within given limits, response to suggestion is the usual behavior in the presence of the proper motor setting, I shall give the results of some recently conducted experiments:

A class of sixty people, made up of high school teachers, grammar grade teachers, social workers, journalists and art students were taking a first course in psychology. They were asked to give attention especially to a test in the acuity of visual perception.

Test A. The two Müller-Lyer figures, on a card, were exposed to view three times, for ten seconds each with an interval of twenty seconds between exposures. After the third exposure the class was asked to state accurately the extent of difference in inches in the length of the two horizontal lines. Seventy-two per cent saw unmistakable differences in the length of the lines, varying from one-half to 3 inches. Twenty-five per cent asserted that they could not see the figures well enough to judge, because they were sitting at varying angles from the card.

Other figures of equal size used were the inclined plane figure; two circles in a triangle, one near the apex and the other near the base; two keystones, one underneath and slightly to one side of the other, and other similar geometric

figures. In each instance the suggestion of inequality of the figures worked, ranging from 80 per cent in the keystones to 64 per cent in the circles.

The success can be attributed to the motor setting: the stop watch, the precise time of exposure and of rest, the introductory discussion of optics with a demonstration of angles of refraction and angles of incidence, a brief allusion to space perception, visual imagery and its psychophysics. All of these preliminary steps prepared the students to accept the perception uncritically, and when their attention was highest they readily responded to the simple suggestion, "how much longer in inches is one line than the other?"

Test B. This was designed to test the acuity of olfactory perception and discrimination. It was explained that what was wanted in this particular instance was a quick response to olfactory perception in actually scenting a new odor. This they were told was not a comparison, nor judgment test, but a test for the acuity of the sense of smell. Two colored mixtures, one water containing carmine and the other dilute methylene blue were used. These two liquids were placed in glass atomizers enclosed in three wrappings. They were carefully and slowly unwrapped in view of the students, mention being made of the volatility of certain aromas and that quick recognition of odor differences was a sign of high discriminating ability as well as a mark of keen intellect and perception. The atomizer with the rose colored liquid was now caused to eject a spray. Six whiffs were liberated, three on each side of the room. No sooner was the spray out of the atomizer than hands were being raised throughout the room to signal that the new odor had been sensed. Fifty-eight per cent immediately declared they perceived a delightful aromatic odor. The windows were now thrown open, ostensibly to clear the room of any vestige of the former aroma, and the blue colored liquid was then sprayed. Hands flew up in the air with such enthusiastic expressions as "What delicate fragrance!" "Such dainty color!" Sixty-one per cent were entrapped this time.

A second experiment was made before a County Medical Society. The Müller-Lyer figures netted 60 per cent of response to the suggestion; two other geometric figures netted 48 and 42 per cent, respectively. The olfactory experiment claimed fewer suggestibles, the reason being that the room was filled with tobacco smoke; even the 16 per cent that did respond was rather large under the existing circumstances. Here too the motor setting and the novel approach succeeded in wresting the attention of experienced physicians from their usual critical attitude and they likewise succumbed to the suggestion.

The contention that suggestion is the uncritical acceptance of a proper motor setting is warranted by this evidence. Suggestion, when used in a specific form, must have three characteristics to be effective: (1) there must be an appropriate motor setting, relevant to the experience of the individual, both in content and extent; (2) the suggestion must be directed toward the formation of a new habit; (3) the individual must accept the suggestion uncritically and act on it. The limitations of suggestion are set only by the content of the individual's life and by his experience.

DISCUSSION

DR. G. A. JAEDE RHOLM (by invitation): I have had little experience with suggestion experiments with adults. I have been working lately on a few experiments on suggestion which may be of interest to those who have children as patients. Almost all investigators of mental development have had a number of experiments on suggestion in their scales. Binet, for example, worked for

years on suggestion. In trying to study personality traits in children of preschool age I have gone back to Binet's book. There is hardly a child who does not become the victim of suggestion in these tests. Gesell, in his series of new tests, has also used a special suggestion test. His experiment is carried out in this way: The child is shown a picture of a man almost falling off a horse; the horse is shying; there is a donkey looking over a hedge at the side. The whole picture is not very clear. This picture is shown to the child for a few moments and then taken away. Then the child is asked, "The man fell off the horse, did he not?" ("Yes.") "The horse was shying, was he not?" ("Yes.") "There was a girl looking over the fence?" The child generally answers yes. I have not yet been able to find one preschool child who does not agree to a suggestion of this kind. Much the same condition might be found through many of the later years. I have been trying for some time with different children to find some other procedure, but so far have not succeeded. For the present it seems impossible to me to understand how psychologists can draw any conclusions as to mental development from the degree of suggestibility a child shows. Almost every one of them, certainly in the preschool age, shows about 100 per cent. What is needed is some sort of situation in which is found degrees of reaction instead of 100 per cent reactions, from which one will be able to measure the degree of suggestibility.

I do not say that I believe suggestibility is the same thing in every individual. It must be different in different children. It must be different in relation to parents and in quite another way to teachers. A great deal is known about sexual development but I am afraid little is known about the development of man in regard not only to suggestion but also to will and imagination. A normal development of will, however, is quite as important as any other consideration in mental hygiene. Experiments in direct will training if carefully handled have, I believe, at times shown good results, but only in peculiar cases. The first step should always be to reduce strain, fatigue and worry if possible, to see how far such a change furthers strength of will and causes the disappearance of a number of concomitant expressions of psychasthenic troubles. More than ever, however, I believe there are cases that are not entirely dependent on such pathologic facts. It is certainly a truism that a child may be weak of will and highly suggestible without any pathologic weakness, as a child may be ignorant without a lack of intelligence.

PROF. L. L. THURSTONE (by invitation): Dr. Olkon has described two interesting experiments in suggestion. His experiments are such that I suppose any of us could repeat successfully. In attempting to measure suggestibility one is confronted with the social factors so prominent in suggestion and so difficult to control for purposes of measurement. I was thinking of a few experiments that Professor Allport of Syracuse has been carrying on. He asked a group of students in Syracuse University to express their opinions on certain social issues including legislative control over the Supreme Court and the prohibition question. He asked the students to run through a list of statements and to check that statement which most nearly agreed with their own opinion. He had ten or twelve statements on every issue. He divided the 300 students into two groups of 150 each, and he gave them all the same list of statements. One group of 150 students filled in their papers when they were sitting in a lecture room, while the other group of 150 students filled in their papers when they were working in the laboratories. He found that the variability of opinion was much greater in the group that answered the questions when they were alone than when they were working together

in the same room. I think one is justified in believing that the mere presence in the same room of other students who are known to be expressing their opinions on the same question tends to make one conform. There is a tendency, under such situations, to be less individualistic in expressing opinions. This is an experimental situation in which the social factor constituted a suggestive influence.

In another experiment Professor Allport asked the students to express their opinions on the social issue by checking one statement which most nearly expressed their opinion. He collected these statements and then informed the students about the majority vote in the class. He then asked the students again to express their opinion on the question, and he found that knowledge of the majority vote influenced the second expression of opinion. Most subjects tended to conform toward the majority vote. He did find a few exceptional students who seemed to be negatively suggestible.

In devising a method of measuring suggestibility, it would be almost necessary to get away from the social situation, because the social influence would not be constant from one occasion to the next. At any rate it can never be exactly controlled. I wonder if the psychophysical experiment with paired judgments could not be used for such a measurement. For example, one might use the lifted weight experiment and present the heavier cylinders on the right side in four-fifths of the presentations. This would constitute a suggestive influence. The proportion of correct judgments would be partly determined by the suggestibility of the subject. In this situation the suggestion is independent of the social situation.

What interested me most in Dr. Olkon's experiment on suggestion was his first remark on the relation of function and structure. Psychology is at present debating the so-called Gestalt issue, which sets out in the foreground this contrast between structure and function. I have talked with Kohler and Koffka on several occasions, and I have tried to read their articles in the hope of understanding what is meant by Gestalt psychology, but I have not succeeded. I am perfectly willing to see analyses made in terms of functional variabilities instead of structural variabilities. That is scientifically legitimate, but I have the impression that the Gestalt psychologists dodge all analyses. They seem to refer their effects in an explanatory way to an undivided unanalyzed total. Most scientists are trained to look for structural variables as their ultimates, but I see no reason why it should not be possible and logical to describe phenomena in terms of functional variables even though it is granted that functional variables may ultimately be reduced to structure.

DR. JAEDERHOLM: I will add a word on a little experiment on suggestion that may interest the members of this society. Sometimes in our psychologic lectures we have to give a short review of psychoanalysis in order to give the students some fair idea of what it is. If we do not say anything about psychoanalysis they will read Freud's books anyhow. During one of these lecture series, when we were studying the emotions and talking about a few of the theories in the psychoanalytic field, the following experiment was carried out: We constructed a number of meaningless syllables, just as G. E. Müller does in his memory experiments, and in two classes wrote a number of such eight-syllable words on the blackboard, the same words in both rooms. All the students knew the technic of free association. One-half were taken into one of the rooms and given a concentrated review of Freud's theory, with some stress put on all kinds of sexual complexes. Another group were taken into another room and given Alfred Adler's theory, with no more about sexual

complexes than belongs to the theory. Then, after a while, we started these students to associate freely from these meaningless syllable words and told them that if they should happen to strike any sexual ideas or complexes of any kind they should not write them out, but just put an asterisk instead in their diagram. The experiments were carried out in this way to find the number of asterisks in both groups. The Freud group had at least twenty times as many asterisks as the Adler group. While this problem was only an instance of suggestion, it might, from another point of view, be of interest to some of the persons who are engaged in psychanalytic problems. The danger of putting in what is later taken out again in the analysis, I am afraid, has been overlooked in some places.

I am grateful for the next point, about the use of psychophysical measures for the measurement of suggestibility. Psychology has reached that stage of today, however, when, for practical purposes, a method that is easy to handle is wanted. I am afraid psychophysical methods take a great deal more time than it is possible to give them. I am not sure, further, whether one boy who reacts in a certain way in a number of psychophysical experiments will show any suggestibility of the same or similar degree on the social side. It is not known whether suggestibility is one thing. There may be twenty different suggestibilities. It is difficult to say whether or not a man who is extremely antisuggestible on one point may not be suggestible on another. Is not the problem rather this—How does he behave under certain circumstances that are mainly social and of greater importance to the boy or to the girl in life? This is why the psychophysical method, important and valuable as it may be, also may lead us easily away from the main question.

DR. OLKON: I am grateful to Professor Jaederholm and Professor Thurstone for their discussion of my paper, which was instructive and helpful. My aim in this paper was to show that suggestion is a dominant factor in normal as well as in abnormal behavior, and its therapeutic value is believed to lie in establishing a proper motor setting, which was the basis of the paper.

ADENOMA OF THE HYPOPHYSIS WITHOUT ACROMEGALY, HYPOPITUITARISM, OR VISUAL DISTURBANCES TERMINATING IN SUDDEN DEATH. DR. ESMOND R. LONG.

This paper will appear in full in a later issue of the ARCHIVES.

Book Reviews

DEMENTIA RACHITICA: STUDIEN ÜBER DIE SOGENANNT ZEREBRALE KOMPONENTE DER RACHITIS. By KURT HULDSCHINSKY. Price: M 2.70. Pp. 60. Abh. aus der Kinderheilkunde u. ihrer Grenzgebieten. Heft 14. Beihefte zum Jahrbuch für Kinderheilkunde. Berlin: S. Karger, 1926.

Symptomatology of Psychic Rickets.—Corresponding to the three stages of the disease, there are three types of psychic disturbance: (a) for the active stage—rachitic catatonia; (b) for the chronic stage and regressive stage—rachitic feeble-mindedness; (c) for the fixed stage of rachitic deformity (dwarfism and scoliosis)—a paranoid late stage. This third stage is wholly independent of the other two and unrelated to them.

a. Rachitic Catatonia: If a child, aged 6 months, suffering from active rickets is studied, one finds the normal cheerfulness replaced by striking depression. The child is weepy; left to itself it lies, dull and apathetic, without interest in the surroundings, without occupation, without the desire to play. This state of apathy or stupor can go so far that objects such as building blocks, set up on the forehead, are allowed to remain—a type of catalepsy. According to Thiemich, even *flexibilitas cerea* occurs at times. The child is anxious, and this anxiety is readily converted to terror. It refuses to allow the doctor near—refuses the simplest examination—refuses to talk. Even when the normal fear reactions of young children is allowed for, this condition in rachitis is so marked that it must be classed as negativism. In addition is found a stereotypy in the form of rhythmic compulsion movements, especially nodding and rolling movements of the head, going on hour after hour—the so-called *spasmus nutans*.

b. Chronic Rickets and Healing Rickets (Metarachitis): If treatment is prompt and adequate, the mental state returns promptly to normal. If delayed or inadequate, the catatonic symptoms disappear more slowly; there remains only a slowing of speech and walking. But even so, in time there is a complete restoration to normal. Even when the child is untreated or the treatment is grossly inadequate, the catatonic condition regresses. Stupor, catalepsy and stereotypy disappear, but some of the negativism remains. These patients show a delay of speech development. This is not a sign of lowered intelligence, for the children can have a good speech understanding, but they will not make the effort to form words. The same is true of walking. In spite of good musculature and firm bones, they refuse to make the effort to walk or stand, not because of any anomaly of innervation but because of a perversion of the movement impulse. As this group is studied, one finds everywhere a relative retardation of function, nowhere a loss of function. All the children are capable of learning. One might say that they represent a concentric retardation of general mental development, a quantitative not a qualitative impairment. The ultimate outcome is a restoration to normal.

c. The Paranoid State of Rachitic Cripples: Many cases of imbecility are associated with defective growth. However, Ziebur's view that defective growth in imbecility is dependent on rickets is not by any means proved. As a matter of fact, rachitic dwarfs are usually intelligent; at the same time they are often peculiar or unusual; often they are droll, consciously or unconsciously

making a virtue of necessity, and turning into fun makers. A point of interest here is the tendency of scoliotic persons in general to psychoses. It may be that the deformity, demanding suppression of many desires, especially sexual, prepares the way, or it may be that the scoliosis was caused by the same thing that caused the mental disturbance, perhaps by intermediation of the endocrine system.

Summary.—In the first stage, negativism and stupor are present, and in the second, dementia, without disturbance of psychic equilibrium. As the stages overlap and run into one another, the author suggests for the whole picture the name dementia rachitica, or rachiticophrenia. This is characterized by the following picture: onset in infancy with neurasthenic symptoms, which gradually reach a peak of catatonic manifestations, clearing up with some persistence of negativism and going over into a period of developmental deficiency, which in turn gradually recovers. Eventually the paranoid complex of the rachitic cripple may develop.

Metarachitic Idiots.—This group includes those cases in which, following severe rickets, irreparable defects persist. The author reports three such cases. In each there is a complicating factor: (1) idiocy on the basis of an hereditary degeneration; (2) mongoloid idiot; (3) cretin or cretinoid idiot. In other words, in all these the mental defect was on an extraneous basis and the rickets merely a complicating incident. The author does not believe that a permanent mental defect can occur on a purely rachitic basis; he believes that statistics reporting from 20 to 30 per cent of defectives as of rachitic origin are false.

The Psychiatric Basis of Dementia Rachitica.—The author points out that the psychic anomalies of the active stages of rickets show a group of symptoms—negativism, catatonia, catalepsy, and stereotypy—such as one is accustomed to see in schizophrenia. At first it seems strange that two such different conditions should show a stage in which the clinical manifestations are so similar. But closer study shows points of contact. On the somatic side, anatomic changes have been found in schizophrenia which suggest a toxic origin, and alteration of endocrine glands, especially the sex glands, is often found in schizophrenia. In rickets one also has to contend with an endocrine disturbance. The effect of cod liver oil—a powerful gland preparation—points to such a connection. Stolzner has shown an influence of epinephrine, and Vollmer has shown benefit from a mixture of various gland hormones. The same relationship is seen if one studies the content of the two psychoses. According to Schilder, schizophrenia represents a level displacement; that is, the patient drops back to an earlier stage representing not only earliest childhood, but long forgotten phylogenetic stages. In rickets there is a similar regression as evidenced by inhibition (negativism) and stereotypy (rhythmic movements).

The displacement in the rachitic person is quantitatively different from that in schizophrenia. The schizophrenic person is at a relatively high developmental stage when the poison strikes; the rachitic person simply remains at the autistic stage of the infant, and only a few symptoms represent a throw-back to the level below the new-born.

What has been referred to as stupor, negativism, catatonia, catalepsy, stereotypy, perseveration, perversion, is, on closer study, nothing more than the expression of a single phenomenon—autism. Autism—the turning away from the world—is normal for the embryo and the new-born, so the change to

reach back to this stage is much less for the rachitic than for the hebephrenic patient. And so rachiticophrenia is not a chance aggregation of independent symptoms, but a reversion, or a stabilization, at the embryonal-infantile level, in which autism dominates the picture, and the relation to the outer world either does not develop or regresses. It differs from schizophrenia in that it is transient and clears up when the metabolic disturbance that causes it clears up. This also explains the intelligence disturbance in rachitic patients. It is not a true defect. It is not an actual disturbance of intelligence, but merely a failure to acquire material. In the period of autism, the child fails to pick up from the surrounding world the material that a normal child will acquire. When the rickets heals, the normal relation to the outer world is reestablished, and that is why permanent intelligence defects do not occur on a rachitic basis.

COMPARATIVE PSYCHOLOGY AND HYGIENE OF THE OVERWEIGHT CHILD. By KATHRYN MCHALE, Teachers' College Contributions to Education, no. 221, 1926. Price, \$1.50.

In the introductory chapter, the author discusses the function of fat and the types and causes of obesity. There is also an abbreviated discussion of gland therapy. The purpose of the work is to make a comparative study of three weight groups of children to determine certain points concerning the physical, mental, emotional, educational and social make-up of overweight children. Children at 11 years of age were selected, and the three groups were composed of: (1) Children weighing 15 per cent or more over normal for the height and age; (2) those between 5 per cent more and 5 per cent less than the norm for the age and height; (3) those weighing less than 8 per cent under normal. There were 100 children in each group, half of whom were male and half female.

A summary of the author's observations is as follows: (1) There was an excess of English, German, Jewish, Italian, and Russian Jewish children in the overweight group, and of German and Irish in the underweight group. There was an apparent inheritance of a tendency to maintain a certain body weight. (2) Classified as to the occupation of the fathers, the commercial group had the greatest number among the overweight while the industrial group had the greatest number among the underweight. (3) Overweight children were found to be tallest, so that some appeared to have normal weight or less. The overweight group was superior in the test of grip, the underweight group being the weakest. The differences as noted by the "rate of movement" test were insignificant, but the overweight group seemed slightly more steady with the right hand. The overweight children were farthest below the norm of vital capacity for their mean weights. (4) Children in the overweight group had had the greatest number of operations and diseases, while in the underweight group they showed the greatest number of general weaknesses and nervous symptoms. About two fifths of all the children had the dental symptomatology of thymic subinvolution. The overweight children were the most mature sexually. (5) In the overweight group, the basal metabolic rate was lower and the nutritive index was higher than in the normal weight group. The basal metabolism indicated that 82.6 per cent were overweight because of exogenous causes. (6) The results of tests of intelligence and educational accomplishment were slightly in favor of those in the overweight group. (7) The overweight and normal children were found to be less distractible and less suggestible and to have more self-confidence than those in the underweight group. (8) Emotional tests indicated that the overweight children had the

greatest tendency to fears and worries, while those in the underweight group had the greatest inclination to pains, weariness, and other physical symptoms. The overweight and the underweight girls were the unhappiest. The underweight children had the greatest tendency to dreams, fantasies and other disturbances of sleep. (9) In regard to the intellectual, social and play interests shown, little difference was manifested in the three groups. (10) The author concludes that overweight children are little different from other children and that the chance differences are for, rather than against, the overweight group.

The subject matter, *per se*, is well done, but it hardly seems probable that the study can be of great practical value because of the differences in the environment and heredity of each child and because of the difficulty in establishing true norms as controls. The author states that it seems impossible to explain the relatively higher educational achievement in the overweight group by the environmental hypothesis, but she apparently fails to consider the relatively better hereditary background in this group. The possible presence of such a factor is shown to a certain extent by the occupations of the fathers. Most of the fathers of the underweight children fell into the industrial group of workers, skilled or unskilled laborers. On the other hand, in the overweight group, a larger percentage of fathers were in commercial occupations. The larger percentage of the children of professional parents fell into either the overweight or normal weight groups. Therefore, the better the environment, the greater the chance of the child being either of normal weight or overweight, and the more likely he is to have a high intellectual capacity.

TRAITEMENT DES MALADIES MENTALES PAR LES CHOCS. By C. PASCAL and JEAN DAVESNE. Paper. Price, 60 cents. Pp. 182. Paris: Masson et Cie, 1926.

The preface of this book probably indicates better the mental attitude of the writers than any other part. Madame Pascal, in speaking of shocks, says "It is in truth in the vast field of miracles that therapeutic shock was born and in which it made its first efforts toward cure. It arises from the profound and mysterious forces of life and appears in the 'concrete and tangible' as a chance phenomenon. It is the unpredictable jet which arises from these fluid sources where the psyche is in perpetual agitation. Capricious in its manifestations, contradictory, often paradoxical, it is the driving force of life which seeks its equilibrium. It pertains to mystery and to the inexplicable by its numerous facets and by its reversibility. Pathogenic, preventive and curative, it encloses in itself both good and evil."

In order to rationalize this shock treatment of the psyche, the author has erected a hypothetical psychocolloidoclastic diathesis, probably in imitation of Widal. "On this special foundation the emotions appear as sudden and intense reactions of releasing accumulated emotional and proteinic impregnations," and she continues, "When the psyche has been sensitized by a primary emotional shock it preserves such a sensibility to specific emotion that another moral shock of the same nature is able to excite crises that otherwise could not have occurred. A primary morbid impression blazes definite pathways and further shocks only follow these channels which have become elective." It is not to be expected that the theory under further elaboration gains any greater clarity. The pathogenic action of an emotional shock is more intense than that of protein shocks. Mental disequilibrium depends on colloidal dispersion. The emotion participating in the organization of psychic sensibility creates the

psychocolloidoclastic diathesis and, by the neurovegetative hemoclastic explosion that it produces, fixes latent psychic syndromes. Since the process of sensitization and desensitization can be worked out for proteins injected into the body, the author has applied the same theory to mental characteristics and speaks of the biomenal phenomena and mental anaphylaxis.

After the elaborate construction of this ingenious hypothesis, the author discusses shock treatments as carried out in the institution. Tuberculin, vaccine, colloidal metals, milk, serum and protonucleinate have joined malaria in innocuous desuetude. Fixation abscess has been the method of choice, being carried out more than 250 times with varying results. The results are mostly favorable according to the tables, although one would wish to know the further progress of these patients. One may get an idea of the enthusiasm of the author, in the section on indications, when she says: "The indications for fixation abscess are numerous. This constitutes the treatment par excellence of all essential and symptomatic agitation. It is indicated in all cases of emergency psychiatry." In the face of this one can only remember the statement of an eminent American psychiatrist: "You can worry a schizophrenic into behaving normally."

THE WHITE SPOTS OF EPILEPSY. By EDWARD A. TRACY. Pp. 129. Price, \$2.50. Boston: Richard Howard, 1926.

In Tracy's words, "These are white spots observable on the arms, the back of the hands, or the face. The spots are chronic in location. They are evidently caused by vasoconstriction." In another place he summarizes the objective phenomena, a majority of which are found constantly in chronic epilepsy, as follows: "(1) Unbalancement of the vasoconstriction reflexes on opposite sides of the body. Normally these reflexes balance, are equal. The unbalancement may be in the time taken for the reflexes to appear (that is, a difference in the reaction times) or it may be a difference in the color of the reactions. (2) A hypertonia of sympathetic fibers (manifested by the intensity in color of the reflex vasoconstriction or by the reflex appearing sooner than is normal). (3) A patchy reflex vasoconstriction, or an absence of the reflex (perhaps due to a degeneration of sympathetic fibers, one of the conditions noted by Echeverria in the postmortems just mentioned). (4) Chronic vasoconstriction spots. These are evidently due to a chronic hypertonia of the particular sympathetic fibers that innervate the musculature of the blood vessels involved in the spots."

Treatment also is considered. It was found that the drug *Oenanthe crocata* caused a slowing of vasoconstrictor reflexes in normal man when injected "into the author's forearm." The drug was therefore tried out on epileptic patients (in colloidal preparation by mouth). Three cases are cited in which the drug had beneficial effect on the seizures and concomitant disappearance of the objective evidences of "sympathetic hypertonia."

The author evidently believes firmly in the theory that vascular spasm causes convulsions and accepts Echeverria's uncorroborated reports of 1870 to prove that there is significant pathologic change in the sympathetic nervous system. In spite of the many obvious weaknesses in anatomy, pathology and physiology, the observations are important and should be repeated by others. It is unfortunate that more clinical and experimental data are not given. The statements are too general to carry conviction; the reasoning often is confused; in composition the book is awkward.

VOM LIEBES UND SEXUALLEBEN. By DR. MED. LUDWIG FRANK. Price, M. 14.40; bound, M. 16.50. Pp. 807. Leipzig: Georg Thieme, 1926.

Dr. Frank passes under sketchy review, in letter-form, about 295 instances in which a mind experienced in dealing with human entanglements is called into solving knotty situations that arise from social or group relationships of the individual. These situations are the cause of untold suffering not only to individuals but also to social groups such as the family when its integrity is threatened. Dr. Frank's treatment of his subject also impresses one with what great frequency these entanglements arise in every sort of community. All the cases he presents are medical in character and rightfully should be handled by a physician. But how many physicians are really competent to deal with them? Dr. Frank gives valuable suggestions as to how one may be enabled to do so. Every physician should familiarize himself with this vast field of cases which is not at all embraced by present day medical practice. Because these patients are shirked and neglected, they fall into the hands of the "irregulars," charlatans and fanatics, to the utter discredit of a backward, unalert medical profession. Dr. Frank's work should be taken as a challenge to enlightenment.

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